Ocean Science
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Interactive comment on "The Pacific-Indian Ocean Associated Mode in CMIP5 Models" *by* Minghao Yang et al.

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General comments:

This is an interesting analysis of the tropical ocean surface temperatures from CMIP5 and HadISST. A 'mode' derived from the tropical Pacific-Indian domain has been denoted the PIOAM by some previous authors, mostly in Chinese journals. It seems worthwhile introducing the approach to this European one.

Here, it is shown that this Pacific-Indian mode (presumably obtained by principal component analysis) from 21 CMIP5 models has much in common with that from observations. There is a lengthy description of the differences among models. The mode is loosely linked to the IOD and ENSO, in section 3.1 of the study. The analysis in

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section 3.2 focuses on alternative IOI and POI indices. A major problem is that a further index PIOAMI is then used as though it is the same as the first one (presumably PC1). Section 4 attempts to relate the differences between models to their differences in formulation. However, this is unconvincing, especially as there is no estimation of statistical uncertainty in results that have been obtained from a single 55-year period. Some conclusions are not well supported.

I initially thought the index might be linked to a 'Pacific-Indian Dipole' that I have used in analysing CMIP5 future climate simulations (see two recent references, below). However, the boxes used in that PID are a little shifted in longitude, so I expect there is only a weak relationship. Nevertheless, it might be worthwhile mentioning that alternative P-I index, and the shift.

The presentation in the paper is superficially quite good. However, there are many important details that are omitted, including in the captions. The 30 points listed below provide some guide to how the presentation needs to be improved. The major problem of having multiple indices, with no statistical uncertainty attached, will need to be overcome before final publication can be considered.

Significant points (at Line numbers):

1. L8-9 This needs to be a more helpful definition of how the PIOAM mode is defined, given that it is a rather new term. 2. L13 Why is HadISST referred to as a reanalysis? I don't think the Met Office does. 3. L46 Walker needs to have a capital W, as it is a person's name -in several places 4. L96 What CMIP5 simulations are used? Historical? 5. L101 Table 1 'oceanic resolution' might not be accurate given some have higher resolution in tropics. Is this the grid for the available ocean data? 6. L104 'Tropics' is normally considered bounded by 23 degrees latitude. Plot 1 shows 20S-20N. Which is used here? What are the longitudinal bounds? 7. L104 Is the analysis done on anomalies around a mean annual cycle? Is the data detrended? 8. L108 How is this 'mode' calculated? I presume it is a principal component / EOF analysis. The interval

C2

of Fig 1, 0.003C makes this seem a very small amplitude. Could these EOF1 fields be scaled so they show the temperature anomaly for a 1 standard deviation of the index or PC1? Do the differences look the same? 9. L119 Error in longitudes for POI -should be 80W not 80E 10. L137 is rather late to state 'so-called'! 11. L138 What depth does heat refer to? 12. L138-140 This needs more discussion, perhaps earlier. What is the mathematical meaning? Should 'presents' be 'represents'? 13. L143 What is the statistical uncertainty of this analysis? There are only 55 years, or 20 ENSO cycles, perhaps. It would be good to obtain additional simulations from at least one model to give some indication. 14. L152 where is the ENSO mode shown? 15. L163-4 what does this mean? 16. L167 In the Fig 1 caption what is the % value? 17. L170 where is the IOD mode shown? 18. L192 It is confusing to have 'MME' of three models. What is MME at L193 and later in the paper? 19. L197 What is Fig. 2 actually showing? Comparisons of EOF1? What is REF? 20. L208 It would seem essential to compare the PC1 of PIOAM with this alternative PIOAMI index. If they are different, then the rest of the paper is misleading, whenever it compares 'PIOAM' with IOD, Nino34 etc. Is the PC1 more closely related to NINO34? 21. L225 What is 'autumn' for a tropical index? 'Boreal', and September-November perhaps? 22. L225-6 needs to be better written. Is this 1SD a criterion? 23. L239 The asymmetry in Fig 5 seems surprising. Does it indicate the index is not a 'normal' distribution? 24. L243 A composite, perhaps? 25. L255 Is this PIOAM or PIOAMI -here and later? 26. L256 Why is it interesting to show a standard deviation, when the IOI and POI are normalised (L120)? How does this impact the interannual autumn values? 27. L280 How is IOD defined here? Is it similar to IOI? 28. L316 This comparison needs to allow for statistical uncertainty, which should be considered early in the study. Would the results be the same if a different set of simulations is considered? 29. L325, L337 these statements are not convincingly proved. 30. L339. What is the chemical process?

Possible references: Watterson IG (2019) Influence of sea surface temperature on simulated future change in extreme rainfall in the Asia-Pacific. On-line, Asia-Pacific J. Atmos. Sci. doi 10.1007/s13143-019-00141-w Watterson IG (2019) Indices of climate

change based on patterns from CMIP5 models, and the range of projections. Climate Dynamics, 52, 2451-2466, doi 10.1007/s00382-018-4260-x

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