

## ***Interactive comment on “The Pacific Ocean heat engine: global climate’s regulator” by Roger N. Jones and James H. Ricketts***

**Anonymous Referee #2**

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"The Pacific Ocean heat engine: global climate’s regulator" Roger N. Jones and James H. Ricketts

This work builds upon a previous study of the authors that showed that decadal scale warming as monitored by Global surface temperature is not "trend-like" but behaves like a progression of fast warmings ("shifts") and periods of stagnation. The present paper tries to relate this concept to processes related to ENSO and the "Pacific heat engine" by statistical analyses of warm-pool and cold-pool temperature time series, their relation to climate indices (PDO,AMO,AMOC...) in the context of shifts. A conceptual model of the heat engine is presented in a second part of the paper.

While I find the concept very interesting and I appreciate the effort of detailed analyses, I found this paper very difficult to read. It is very long, wordy and not very focused.

C1

The many statistical analyses and detailed descriptions are difficult to follow. How the conclusions made in the text arise from the Figures is mostly difficult to see.

The following changes need to be made before it can go into a more rigorous review of the science:

- 1) The paper should be substantially shortened. I suggest to leave part 2 out and leave it for a separate paper.
- 2) Introductory material is mixed-in with the results. Please clearly distinguish between introduction/discussion of previous work and unique results from the present study.
- 3) I suggest a clear re-structure of the paper: Describe in the introduction in a focused way the starting point, also the state-of-the art with respect to the relation to climate indices etc (a lot of this now is mingled in with the results sections). It should be clearly stated at the end what hypotheses you are investigating or which questions you are addressing. After the introduction, there needs to be a methods and data section where the statistical methods are explained and data described. At present, this is all in the SI, and e.g. the "tracking model" and how it is used is unclear. The methods section needs to lay out how the hypotheses will be tested with the statistical methods. The results sections are overloaded with detailed information but the storyline is not clear. Methods description and results need to be delineated. The text needs to directly refer to the Figure panels so one can track the conclusions drawn.
- 4) Use present tense when referring to the results. It is very difficult to track whether described results are from the present study or referring to some previous results.
- 5) There are many unclear and unscientific phrases throughout the paper: e.g.: ... "the heat engine is networked within the climate system" (abstract)... Examples from the intro: ...the process is "regulated" by a heat engine spanning ... ...shifts are "linked to the wider system of climate oscillations"... ...the difference between "this" and the standard model "in terms of energy flow" .. ...how it interacts with "broader climate"...

C2

section 2: ...heat "being channeled and made available for dissipation"... page 11: ..."because of issues with".... page 17: ...the "tightening of the system" coincided with the heat engine moving from free to forced mode... etc. There is a need to go through the paper again and make statements as clear and scientific as possible.

Structural comments:

Figure 1a is something you find in any climate/ocean dynamics textbook. Instead of this rather basic Figure it would be better to redraft something related to the heat engine hypothesis, recharge-discharge theory with focus on your hypothesis.

Section 1: Bullet points 1-6 read like the conclusions section from the Jones and Ricketts 2017 paper and are not needed in this way here. Line 77: what is meant by subsequently and elsewhere? Line 84: here, hidden in a side sentence, it is stated for the first time what is the subject of the paper. It is not clear though what is meant by "processes" because I find this paper to be mainly about statistical analyses and not necessarily the underlying processes.

Section 2 and the beginning of section 3 are introduction material. What exactly do you mean by heat engine "behaviour" in the title section 3? Line 158 suddenly results start. Lines 169 ff: too many numbers, difficult to follow. Section 3.1: first sentence: where do you show this? explain tracking model in methods, it is otherwise very difficult to follow section 3.1 Section 4: First sentence: where do you show this? Lots of material and references to previous studies to be moved and discussed in introduction.

Section 5.3: is this needed? It seems like a proper analysis and description of climatological data is enough.

Conclusions: here I suggest to clearly distinguish what are new hypotheses and interpretations rather than conclusions drawn from the statistical analyses in this paper. A clear summary of the statistical results needs to be presented first.

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2019.