

Ocean Sci. Discuss., referee comment RC2  
<https://doi.org/10.5194/os-2021-1-RC2>, 2021  
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## Comment on os-2021-1

Anonymous Referee #2

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Referee comment on "Progress in understanding of Indian Ocean circulation, variability, air–sea exchange, and impacts on biogeochemistry" by Helen E. Phillips et al., Ocean Sci. Discuss., <https://doi.org/10.5194/os-2021-1-RC2>, 2021

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This is a timely review that updates popular earlier reviews by Schott and McCreary (2001) and Schott et al. (2009). The difference is that a large group of authors wrote this review. As such, the coverage of various topics is at places uneven and the quality of the writing is variable. Sections 4.2.3 and 4.2.4 are good in coverage and readability. The discussion of biogeochemical variability helps bridge to communities beyond physical oceanography.

### Major comments

The paper can benefit from better integration of different parts, possibly written different authors. A more balanced presentation among topics covered also helps, especially on climate. Here are some examples.

1. Abstract promises to bring together three major areas of research: the Indian Ocean circulation patterns, air-sea interactions, and climate variability. Reading the paper, I felt that that the emphasis was clearly on the ocean circulation while the latter topics did not receive as much attention. The Indian-western Pacific ocean capacitor (IPOC) perhaps represents an important advance in coupled ocean-atmosphere dynamics in the region but was hurried through in a single paragraph of 12 lines, including climate change, although it is a cross-basin mode (Xie et al. 2016, Adv Atmos Sci) with well-documented impacts on monsoon rainfall from India (Z. Zhou et al. 2019, GRL) to China and Japan (K. Hu et al. 2019, JC). In comparison, the text is 80 pages long, the Indian Ocean dipole (IOD) received a coverage of 4 pages and Ningaloo Niño 2 pages. This seems a lack of representation of IPOC research in the author team but a balanced approach is needed.

2. Abstract promises to discuss the role of the Indian Ocean in climate change. L80-81: "This coupling (not sure what's this coupling) ... causing a hiatus in the warming of Earth's

surface atmosphere (Section 6)." I did not see further discussion of this topic in section 6, which is entitled "Modes of Interannual Climate Variability".

L135-136: "The Indian Ocean accounts for 50-70% of the total anthropogenic warming in the global upper (700 m) ocean." This seems an overstatement. Do we even know how much "the anthropogenic warming" there is in the ocean? Does this merely refer to the trends over a certain time period?

Additional comments

Figure 1 is hard to read. It's probably from a ppt slide, which seems to include many layers of animation.

L296. "the SST variability is predominantly generated by variability in surface heat fluxes in the Seychelles-Chagos Thermocline Ridge." Shouldn't it first mention that intraseasonal SST variability is large in this region (e.g., Saji et al. 2006, GRL)? I understand the need to emphasize recent results but a big picture needs to be presented first.

L398-400. Is it really relevant to discuss Pacific TIWs?

L520-521. "The Agulhas variability is linked upstream to the IOD, SIOD and ENSO..." Is there a literature to back this up?

L830-832. The semi-annual cycle in the zonal wind over the equatorial Indian Ocean is well known observationally but was never explained physically. Ogata and Xie (2011, JC) showed that it's due to the meridional advection of easterly momentum by the cross-equatorial monsoon winds.

Does Figure 13 need to show two operational products?

L1460-1461. The projection was challenged by G. Li et al. (2016, JC), a paper entitled "A robust but spurious pattern of climate change in model projections over the tropical Indian Ocean."

Section 8 could be stronger. What happened during the 12-month period of Sept 2019-August 2020 showed that we don't know the Indian Ocean very well as a driver of major climate anomalies in the rim countries. The period opened with a record IOD (Doi et al. 2020; Du et al. 2020, GRL) and ended with historic heavy rainfall in China and Japan that have been attributed to a strong IPOC event (Takaya et al. 2020, GRL; Zhou et al. 2021 PNAS), all without major ENSO signals in the Pacific. I don't think we know well how this chain of events happened in the Indian Ocean but clearly we should.

Several papers were cited in the text but not in References.

L368. Zhou et al. (2017a, b)

L391. Xi et al., 2015. Is it a typo of Xie et al. (2006, JC) on orographic effects on monsoon rainfall?

L1352. De Boer et al., 2013.

L1429. Xie et al. (2009)

L1432. Zheng et al. (2013)