

The Cryosphere Discuss., referee comment RC2
<https://doi.org/10.5194/tc-2021-216-RC2>, 2021
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Comment on tc-2021-216

Anonymous Referee #2

Referee comment on "A strong link between variations in sea-ice extent and global atmospheric pressure?" by Jean-Louis Le Mouël et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-216-RC2>, 2021

General Comments

"A strong link between variations in sea-ice extent and global atmospheric pressure" by Le Mouël et al applies the singular spectrum analysis (SSA) method to both Arctic and Antarctic sea ice and sea-level pressure (SLP) time series to identify and compare common sets of harmonics between the respective time series. Further, temporal comparisons are made between sub-annual to multidecadal harmonics, and those of longer periodicity in the ice cover and SLP data are related to astronomical and astrophysical forcing cycles. A researcher with expertise in such cycles would be better equipped to evaluate and offer an opinion on the validity of such arguments in the context of both past and modern cryospheric change. However, that said, it is not apparent what the key, novel findings are from the study. My additional comments herein mainly encompass data and methodology concerns.

Seasonal change has a clear impact on ice growth and melt, but how climate change and related oceanic and atmospheric warming of the last two plus decades factor into the interpretation of these results is unclear. Further, to provide longer-term context to the results, the conclusions attempt to offer some insights between ice cover and SLP beyond the satellite era. This is problematic due to sparse data over the polar oceans (especially Southern Ocean) until the 1950s and thus likely impacts confidence in the the sea ice and SLP periodicities calculated over that period, though no error estimates are provided accounting for this shortcoming. Below I outline more detailed concerns along these and editorial lines.

Specific Comments

1) To reiterate, seasonal temperature and pressure changes due to annual earth-sun relations certainly impact the annual cycle of ice growth and melt and presence and strength of climatological pressure features. From SSA applied to sea ice and pressure time series, we would expect related "cycles" to emerge at seasonal and annual scales through time. The rates of Earth's air/ocean temperature changes, however, are not nearly as consistent through time. Is SSA an appropriate methodology to measure such evolving and covarying sea ice and SLP change? How does global climate change and related oceanic and atmospheric warming exacerbated at both poles during at least the last two decades (i.e., Arctic amplification) factor into the interpretation of your results and the purported astronomical and astrophysical forcings linked with non-stationary sea ice and perhaps SLP behaviors?

2) For satellite-era comparisons against sea ice variability, why use the coarse resolution HadSLP2 and not a newer, higher spatiotemporal resolution product such ERA5? There is quite a difference in spatial resolution between these two products and ERA5 assimilates lots of new data sources. At minimum, more justification for HadSLP2 over a newer product like ERA5 needs to be provided. The data quality/quantity issue further plays into the longer-term interpretation of results mentioned in the following comment.

3) In providing long-term context to the core study results, the conclusions need to be modified. Meteorological data including surface pressure is very sparse for the Southern Ocean and Antarctica, especially prior to the IGY (~1957-1958). This data quantity issue is recognized in the conclusions of Allan and Ansell (2006), which provides an overview of the HadSLP2 dataset used in the paper. Further, many gridded products have questionable data quality with a scarce number of observations included before the first half of the twentieth century (Fogt et al., 2018 J. Climate). How sparse are Southern Ocean data observations comprising the HadSLP product pre-dating the satellite era, let alone during this era from which the main results are built? Much like the passive microwave ice cover record, a description of the HadSLP dataset construction and available observations through the pressure record need to be discussed and results emphasized for periods when the data quality/quantity are most robust. These dataset issues need to be kept in perspective when interpreting the results back beyond the IGY and to the 1840s.

Technical Corrections

Some editorial remarks and clarifications are listed by line number (L):

L17: "It fits topographic forcing." – what does? Please clarify.

L44: Change "identifications" to "identification"

L48: Spell out the climate indices (e.g., AO, AAO) where first introduced.

L51-52: The AO is commonly a statistical solution based on a univariate geopotential height field (e.g., NOAA CPC uses the 1000 hPa GPH field). Please clarify this description.

L63: Remove "lod"

L67: This sentence is confusing. Please re-write to clarify its intent.

L84: "quoting Cavalieri et al" with what? Methods? Please clarify what is meant here.

L116: The Allan and Ansell paper was published in 2006 not 2004.

L120: In addition to specific comments above, references to previous studies that have used the data for polar research would help support the statement.

Figure 2 (and others): Y axis labels referencing surface pressure should consistently list "hPa." Check that these pressure units are consistently referenced through the paper.

L297: Reference and description of the earth-sun distance data should be provided in the data section.