



*Supplement of*

## **Impact of the Indian Ocean sea surface temperature on the Southern Hemisphere middle atmosphere**

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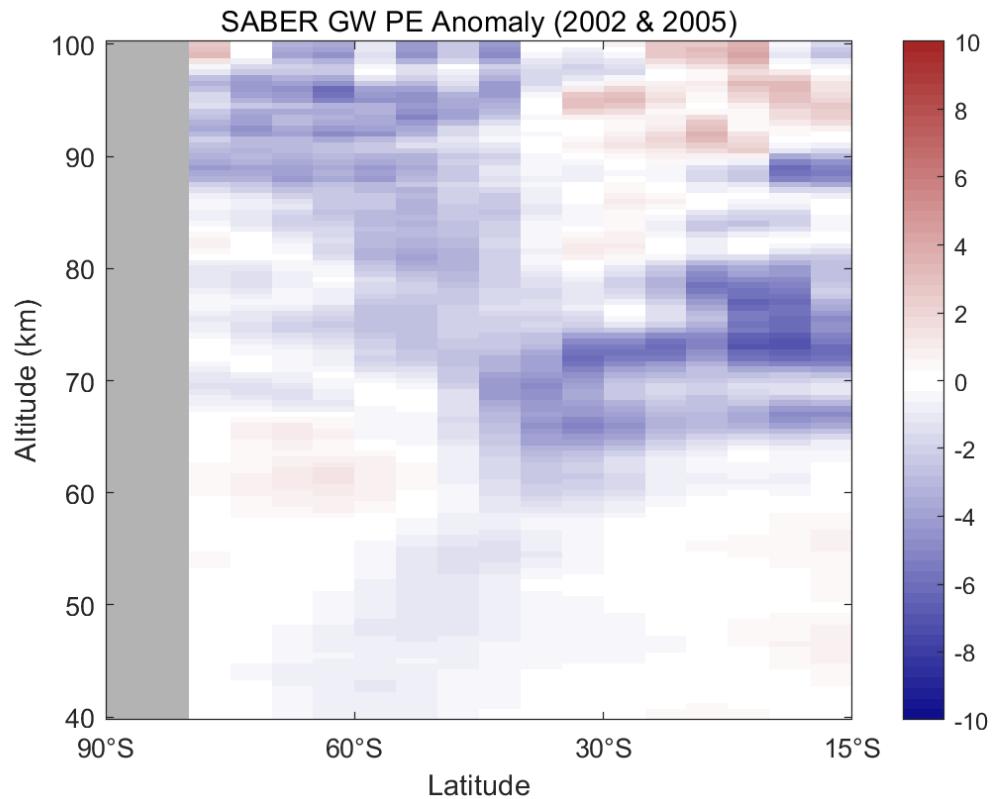
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## **S1. SABER Gravity-Wave Potential Energy as Qualitative Observational Support**

To provide an observational context for the proposed gravity-wave filtering mechanism in the mesosphere–lower thermosphere (MLT), we examined gravity-wave potential energy (GWPE) derived from SABER temperature measurements for the limited period overlapping with robust MIOD events. Because SABER observations in the Southern Hemisphere are available only from mid-July onward each year, and the SABER record overlaps with only two well-defined positive MIOD events (2002 and 2005), the available data do not permit statistically meaningful composites or regression analyses that can isolate MIOD-related signals from other sources of interannual variability (e.g., ENSO, QBO, or volcanic effects). In addition, SABER-derived GWPE characterizes wave amplitude but does not provide information on propagation direction or momentum flux, precluding a direct observational diagnosis of gravity-wave drag.

Nevertheless, as qualitative case studies, detrended GWPE anomalies were examined for 2002 and 2005. In both years, reduced GWPE is evident above  $\sim$ 60 km in the winter midlatitudes during mid-July to late August, which is qualitatively consistent with enhanced filtering of gravity waves by strengthened stratospheric westerlies during positive MIOD conditions. While these results cannot establish causal attribution, they provide observationally grounded, non-conclusive support for the plausibility of the gravity-wave filtering mechanism discussed in the main text.

**Figure S1.**



Mean detrended anomalies of SABER-derived gravity-wave potential energy (GWPE) for (a) 2002 and (b) 2005. Anomalies are computed relative to the 2002–2022 climatology after removing the linear trend. Gray shading denotes regions with missing data due to SABER sampling limitations.