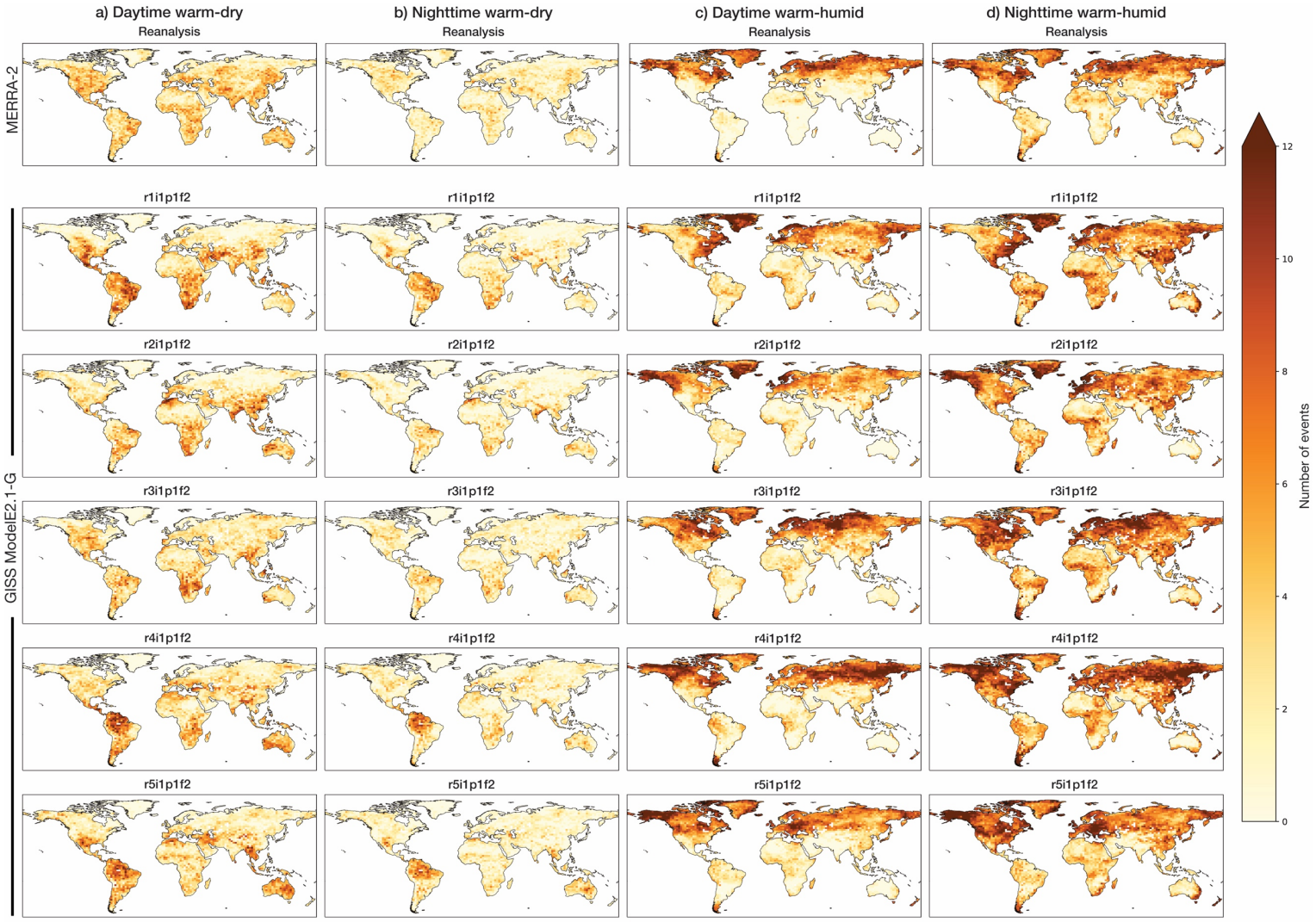
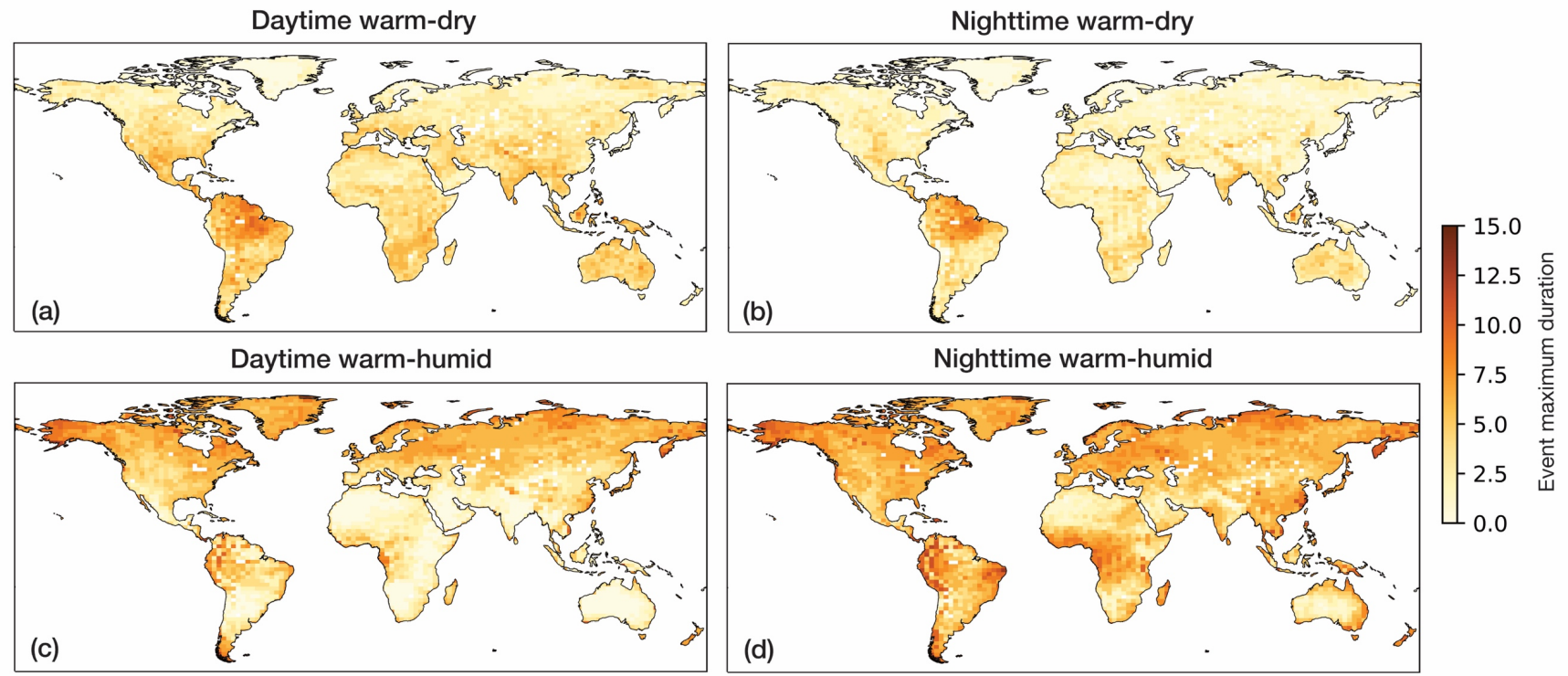
Supplemental Materials

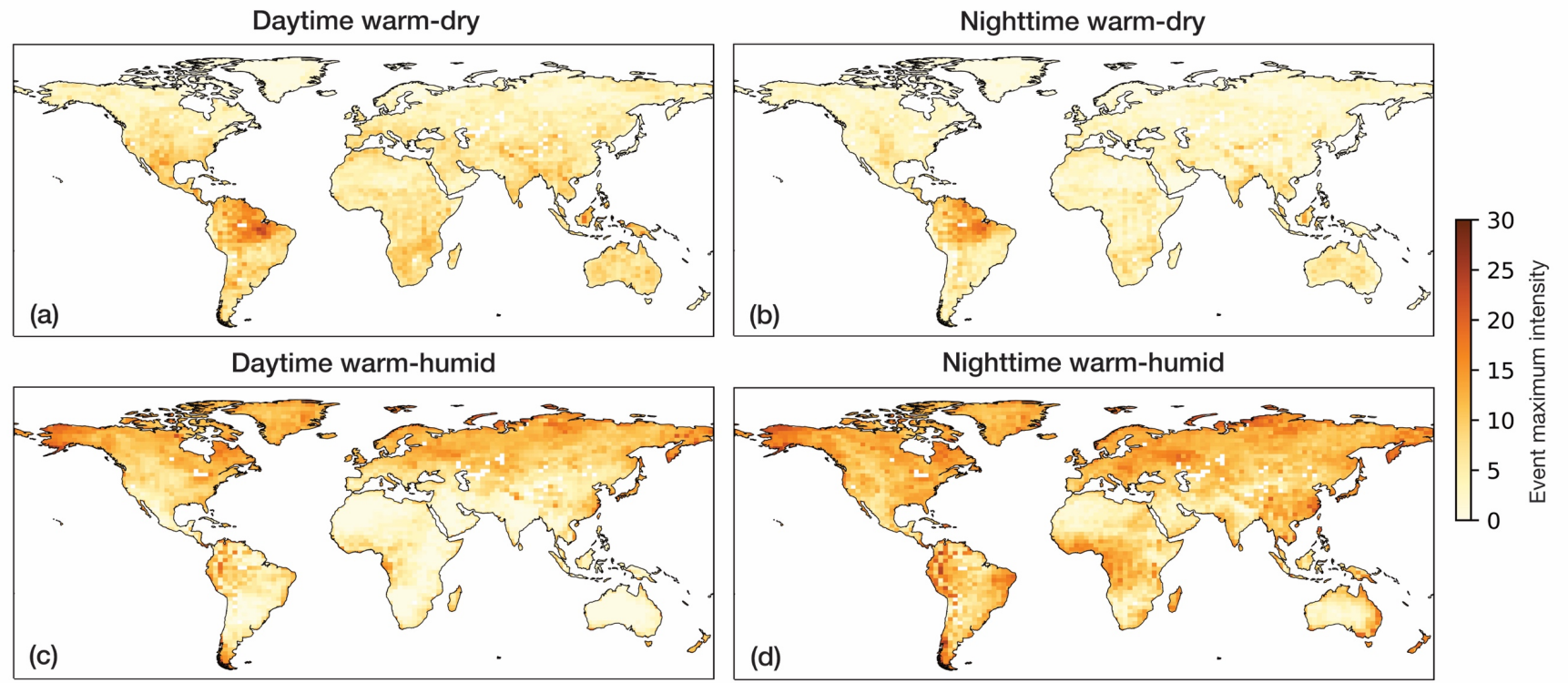


SM Figure 1. **MERRA-2 reanalysis and GISS ModelE2.1-G r[1-5]i1p1f2 historical global distributions of warm-dry and warm-humid 1981-2014 event frequency with events defined by a 90th percentile threshold.** a) Daytime (Tmax) warm and dry event frequency. b) Nighttime (Tmin) warm and dry event frequency. c) Daytime warm and humid event frequency. d) Nighttime warm and humid event frequency.

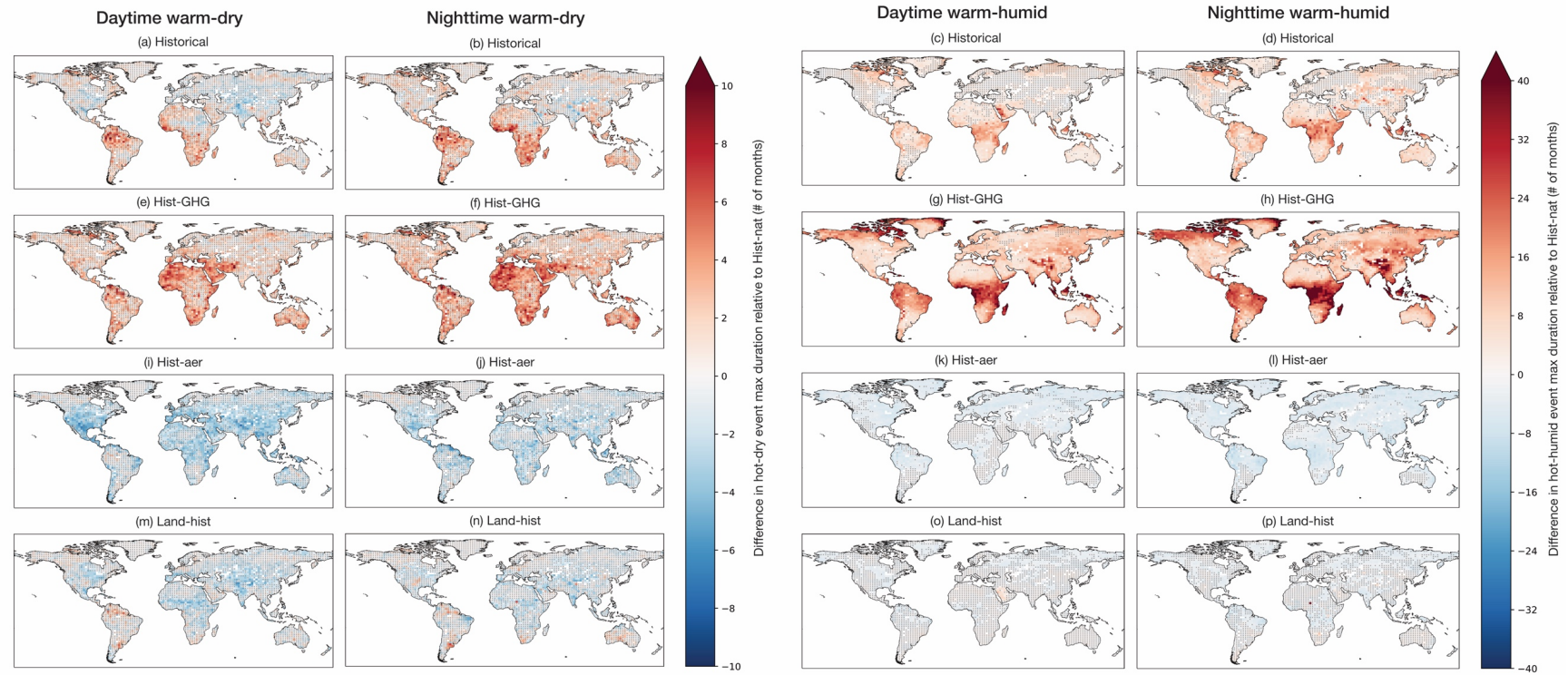
Here, we present the frequencies of daytime and nighttime warm-dry and warm-humid events based on the MERRA-2 reanalysis and individual GISS ModelE2.1-G ensemble members. Overall, the GISS model ensemble members adequately represent the global spatial distributions of these compound events when compared to the MERRA-2 reanalysis in the available time period of 1981-2014. However, across the ensemble members, we note that there are differences between the reanalysis and the model simulations. For example, r1i1p1f2, r4i1p1f2, and r5i1p1f2 display much higher numbers of daytime and nighttime warm-dry events in regions such as the Amazon, which may be attributed to precipitation biases in the GISS model as noted by Kelley et al. 2020. For daytime and nighttime warm-humid events, there are also discrepancies between the reanalysis and model simulations across the lower latitudes, which may be due to differences in how the strengths of the relationships between maximum temperature, minimum temperature and humidity are depicted in MERRA-2 and the GISS model. For all event types, we also see that the internal variability of the GISS model also contributes to notable regional variations between the ensemble members (for example, North America represented by r1i1p1f2 vs r2i1p1f2). Despite this, each ensemble member consistently shows the differences across each event type as seen in the MERRA-2 reanalysis.



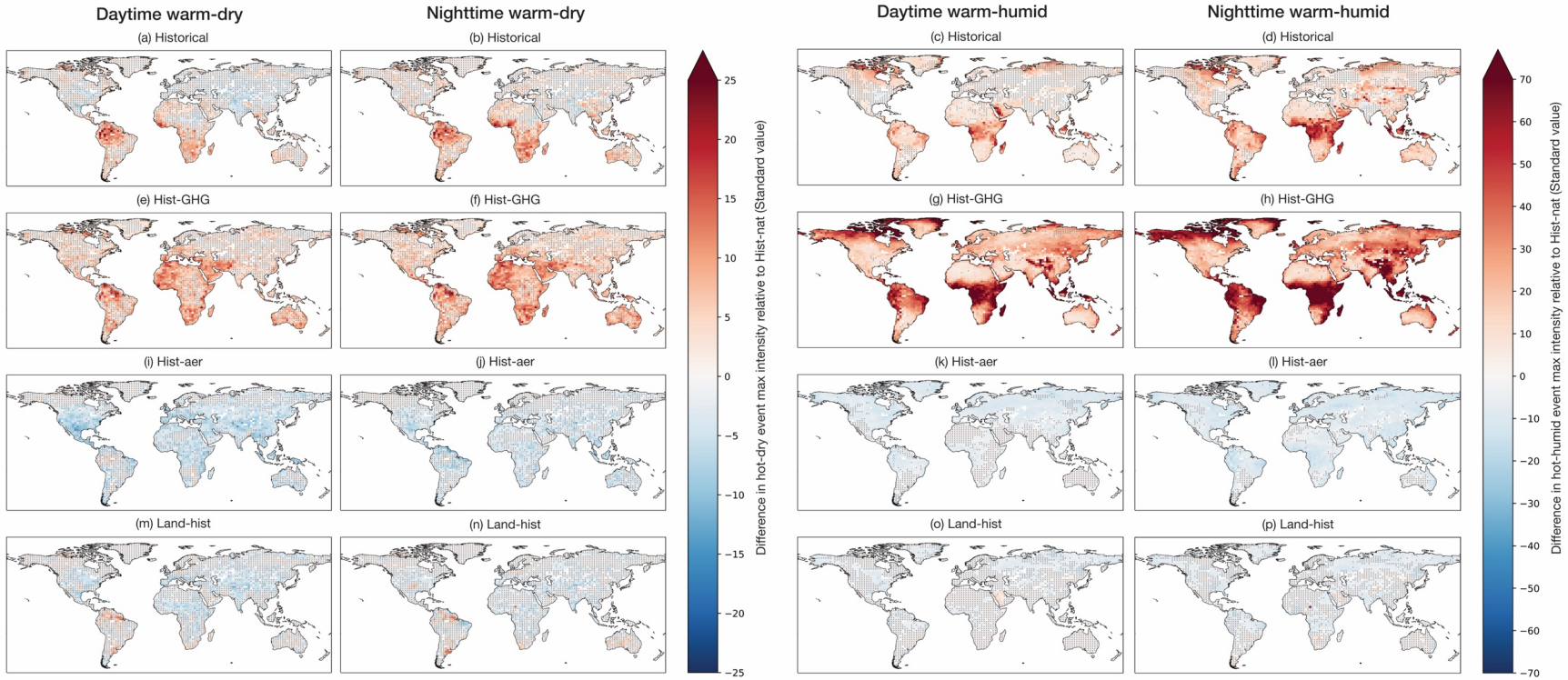
SM Figure 2. **GISS ModelE2.1-G r[1-5]i1p1f2 historical natural-only global distributions of warm-dry and warm-humid 1955-2014 event maximum duration based on a 90th percentile threshold.** a) Ensemble median daytime (Tmax) warm and dry maximum event duration (number of months). b) Median nighttime (Tmin) warm and dry max event duration. c) Median daytime warm and humid max event duration. d) Median nighttime warm and humid max event duration.



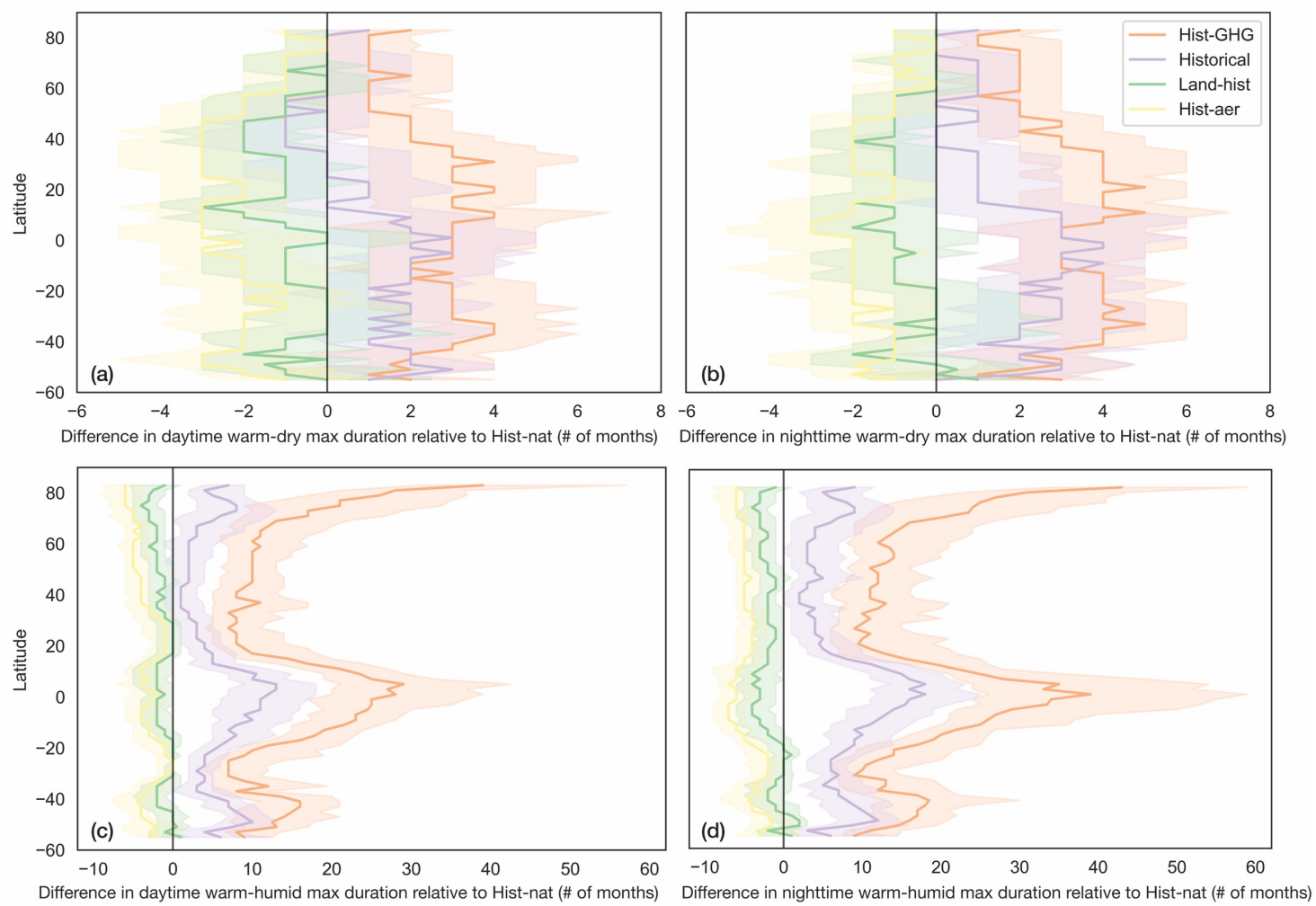
SM Figure 3. **GISS ModelE2.1-G r[1-5]i1p1f2 historical natural-only global distributions of warm-dry and warm-humid 1955-2014 event maximum intensity based on a 90th percentile threshold.** a) Ensemble median daytime (Tmax) warm and dry maximum event intensity (standard value). b) Median nighttime (Tmin) warm and dry max event intensity. c) Median daytime warm and humid max event intensity. d) Median nighttime warm and humid max event intensity.



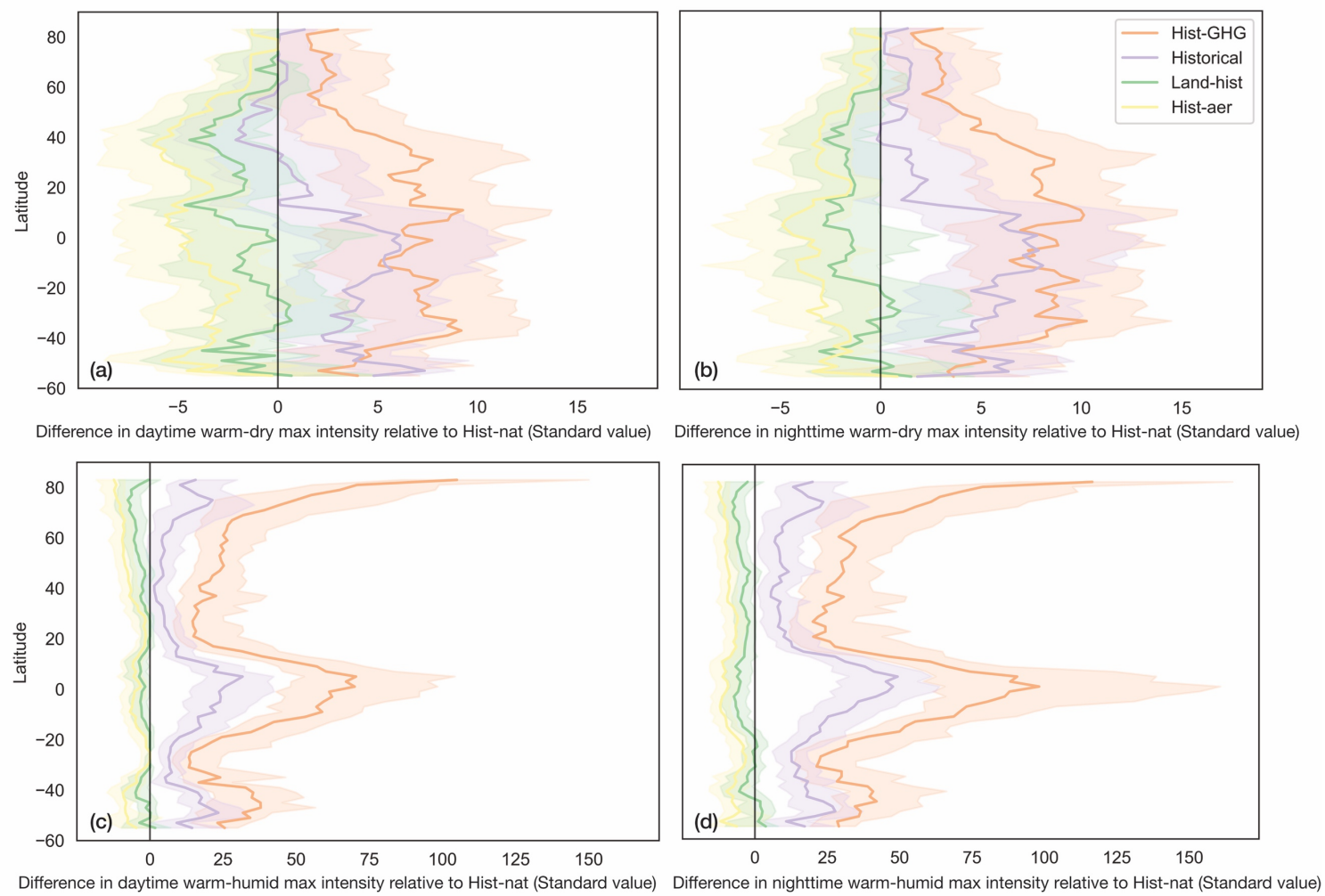
SM Figure 4. GISS ModelE2.1-G r[1-5]i1p1f2 forced difference in warm-dry and warm-humid 1955-2014 maximum event duration relative to historical natural-only conditions based on a 90th percentile threshold. Each column presents the historical, hist-GHG, hist-aer, and land-hist difference in the max event duration relative to the historical natural-only max event duration (number of months). Grid cells where not all ensemble members agree on the sign of the forced event duration difference relative to hist-nat are hatched.



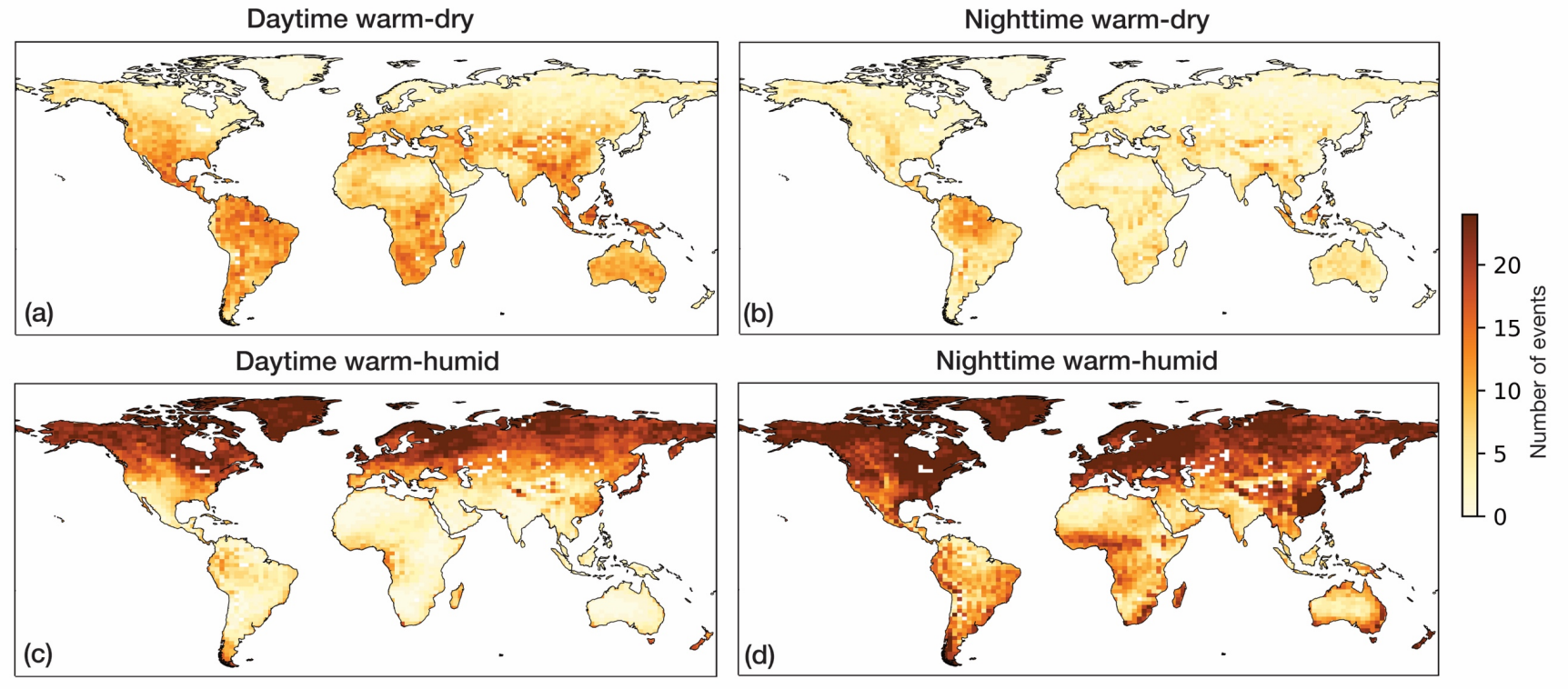
SM Figure 5. GISS ModelE2.1-G r[1-5]i1p1f2 forced difference in warm-dry and warm-humid 1955-2014 maximum event intensity relative to historical natural-only conditions based on a 90th percentile threshold. Each column presents the historical, hist-GHG, hist-aer, and land-hist difference in the max event intensity relative to the historical natural-only max event intensity (standardized value). Grid cells where not all ensemble members agree on the sign of the forced event intensity difference relative to hist-nat are hatched.



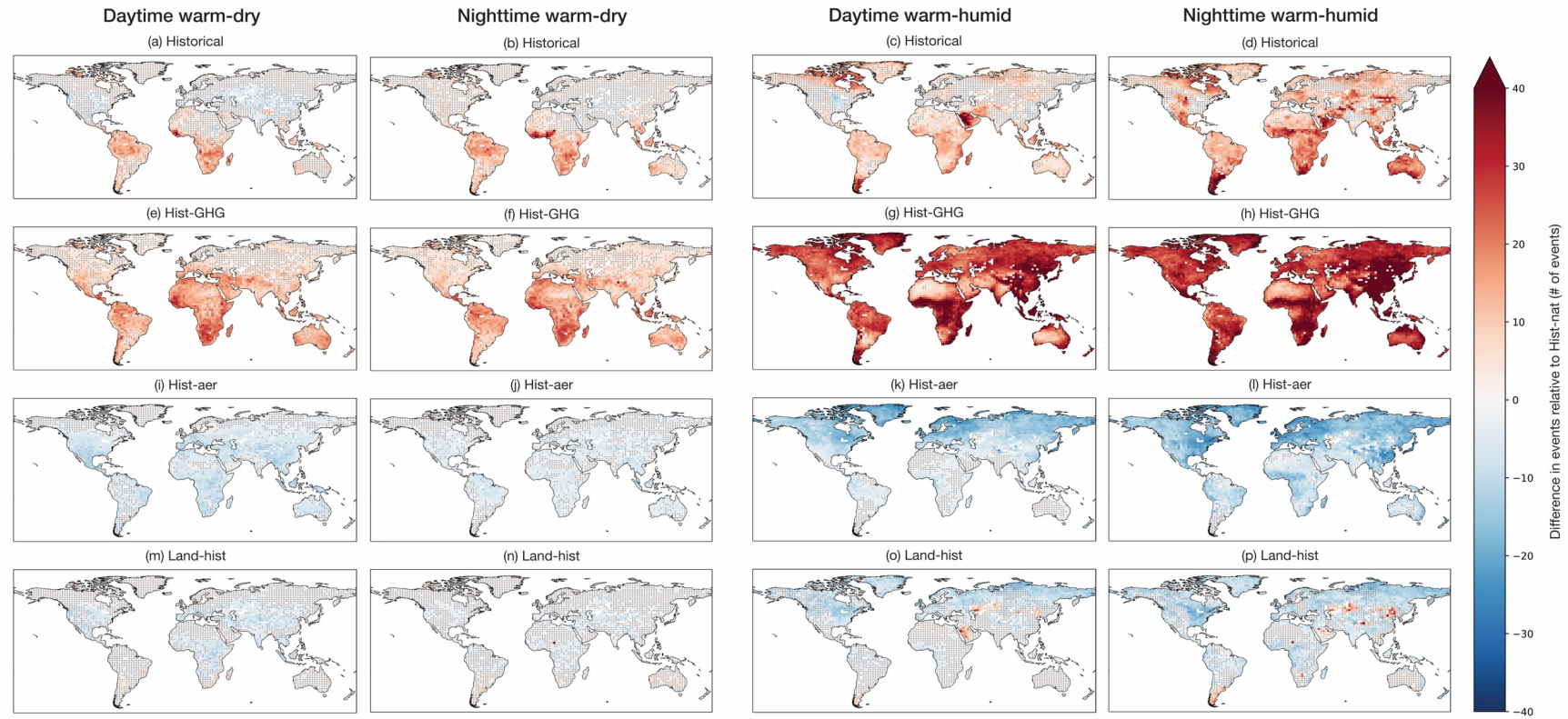
SM Figure 6. Latitudinal distributions of differences in warm-dry and warm-humid maximum event duration relative to historical natural-only conditions. a) Pooled ensemble median and interquartile range (IQR) for daytime warm and dry max event duration at each latitude band for historical, hist-GHG, hist-aer, and land-hist (number of months). b) Pooled ensemble median and IQR for nighttime warm and dry max event duration. c) Pooled ensemble median and IQR for daytime warm and humid max event duration. d) Pooled ensemble median and IQR for nighttime warm and humid max event duration.



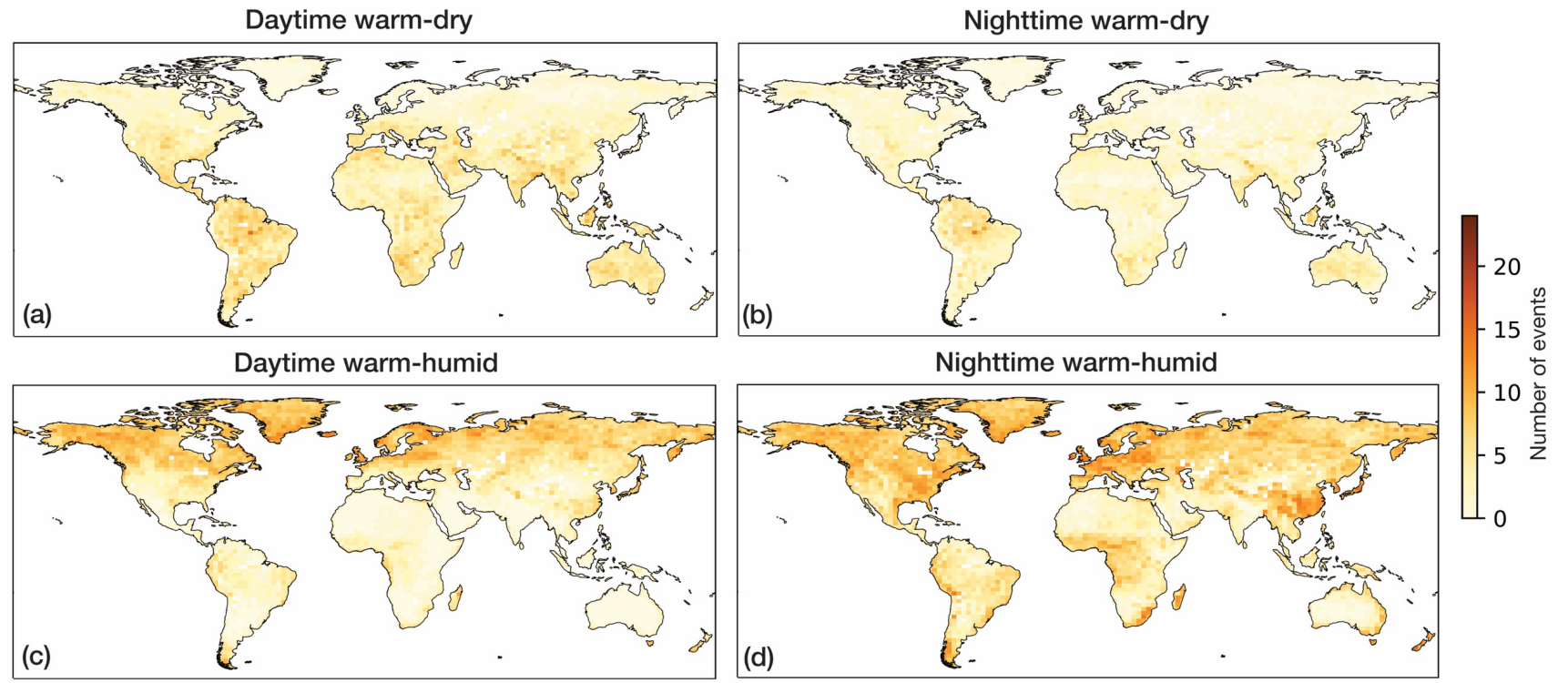
SM Figure 7. Latitudinal distributions of differences in warm-dry and warm-humid maximum event intensity relative to historical natural-only conditions. a) Pooled ensemble median and interquartile range (IQR) for daytime warm and dry max event intensity at each latitude band for historical, hist-GHG, hist-aer, and land-hist (standardized value). b) Pooled ensemble median and IQR for nighttime warm and dry max event intensity. c) Pooled ensemble median and IQR for daytime warm and humid max event intensity. d) Pooled ensemble median and IQR for nighttime warm and humid max event intensity.



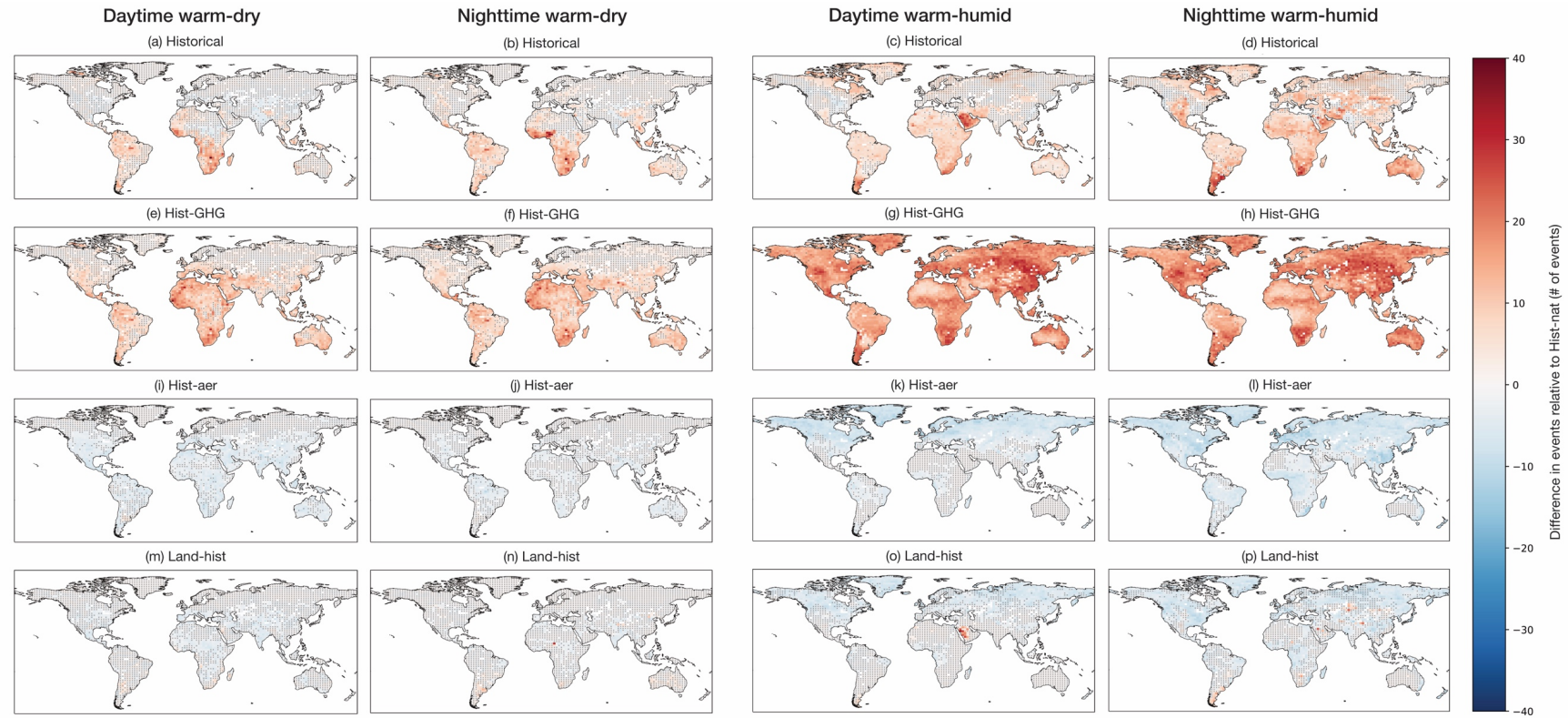
SM Figure 8. **GISS ModelE2.1-G r[1-5]i1p1f2 historical natural-only global distributions of warm-dry and warm-humid 1955-2014 event frequency based on a 3-month window.** a) Ensemble median daytime (Tmax) warm and dry maximum event intensity (standard value). b) Median nighttime (Tmin) warm and dry max event intensity. c) Median daytime warm and humid max event intensity. d) Median nighttime warm and humid max event intensity.



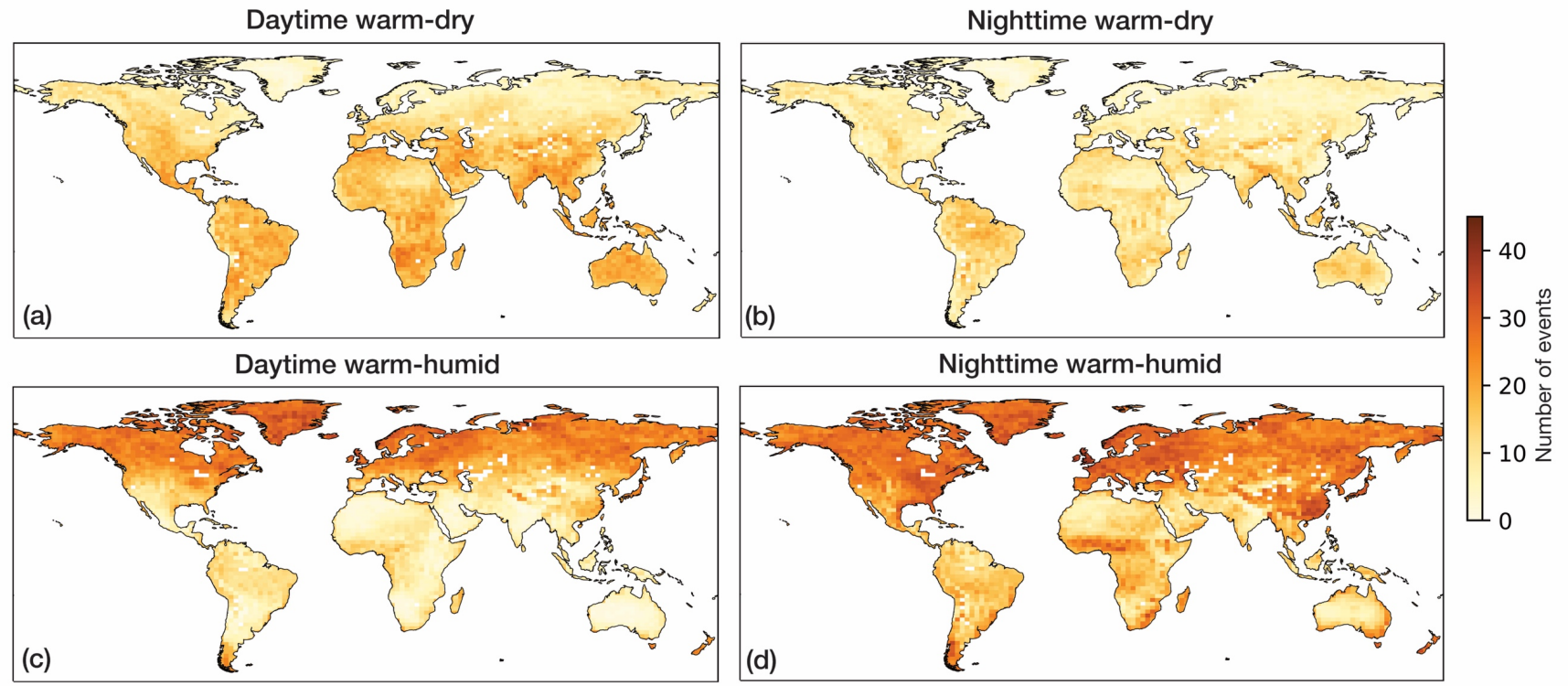
SM Figure 9. GISS ModelE2.1-G r[1-5]i1p1f2 forced difference in warm-dry and warm-humid 1955-2014 maximum event frequency relative to historical natural-only conditions based on a 3-month window. Each column presents the historical, hist-GHG, hist-aer, and land-hist difference in the event frequency relative to the historical natural-only event frequency (units in number of events). Grid cells where not all ensemble members agree on the sign of the forced event frequency difference relative to hist-nat are hatched.



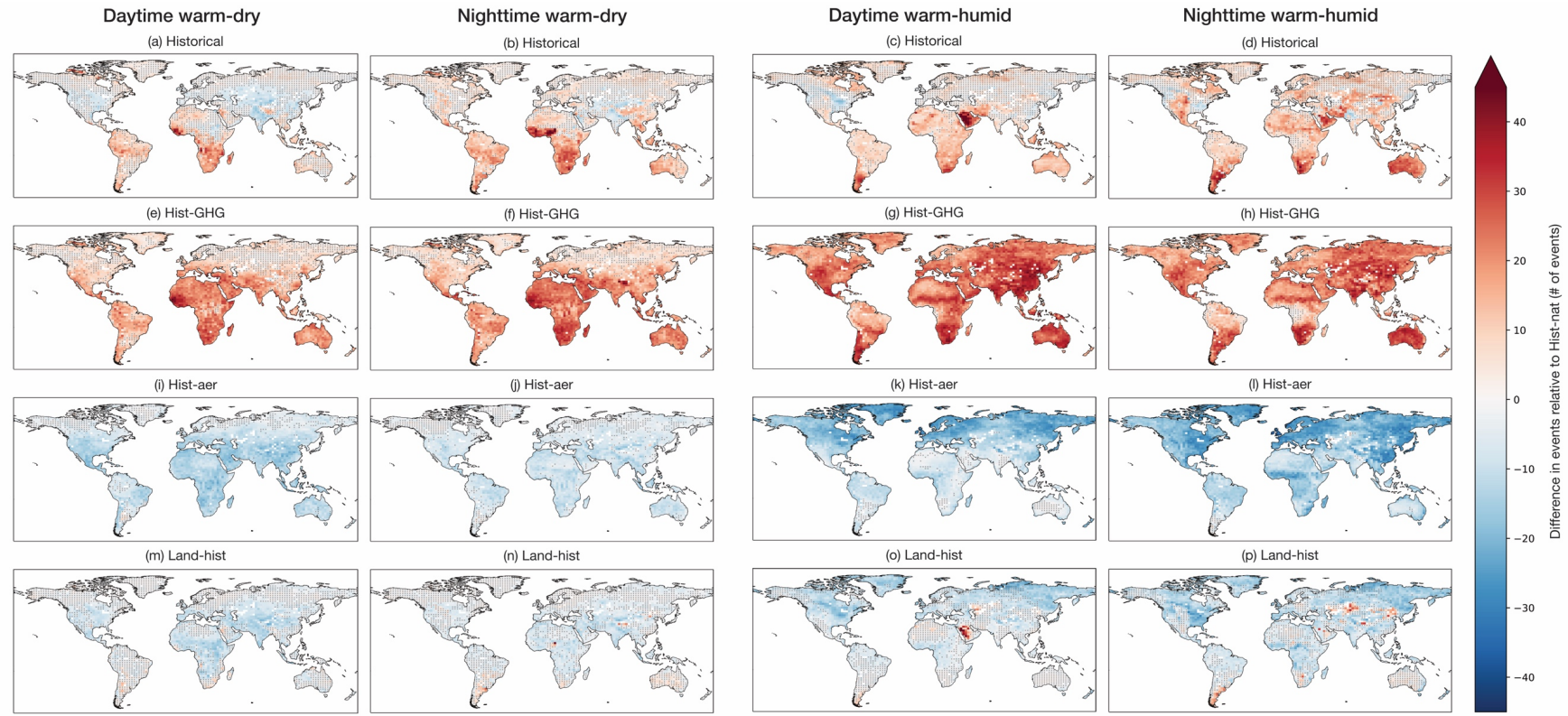
SM Figure 10. **GISS ModelE2.1-G r[1-5]i1p1f2 historical natural-only global distributions of warm-dry and warm-humid 1955-2014 event frequency based on a 12-month window.** a) Ensemble median daytime (Tmax) warm and dry maximum event intensity (standard value). b) Median nighttime (Tmin) warm and dry max event intensity. c) Median daytime warm and humid max event intensity. d) Median nighttime warm and humid max event intensity.



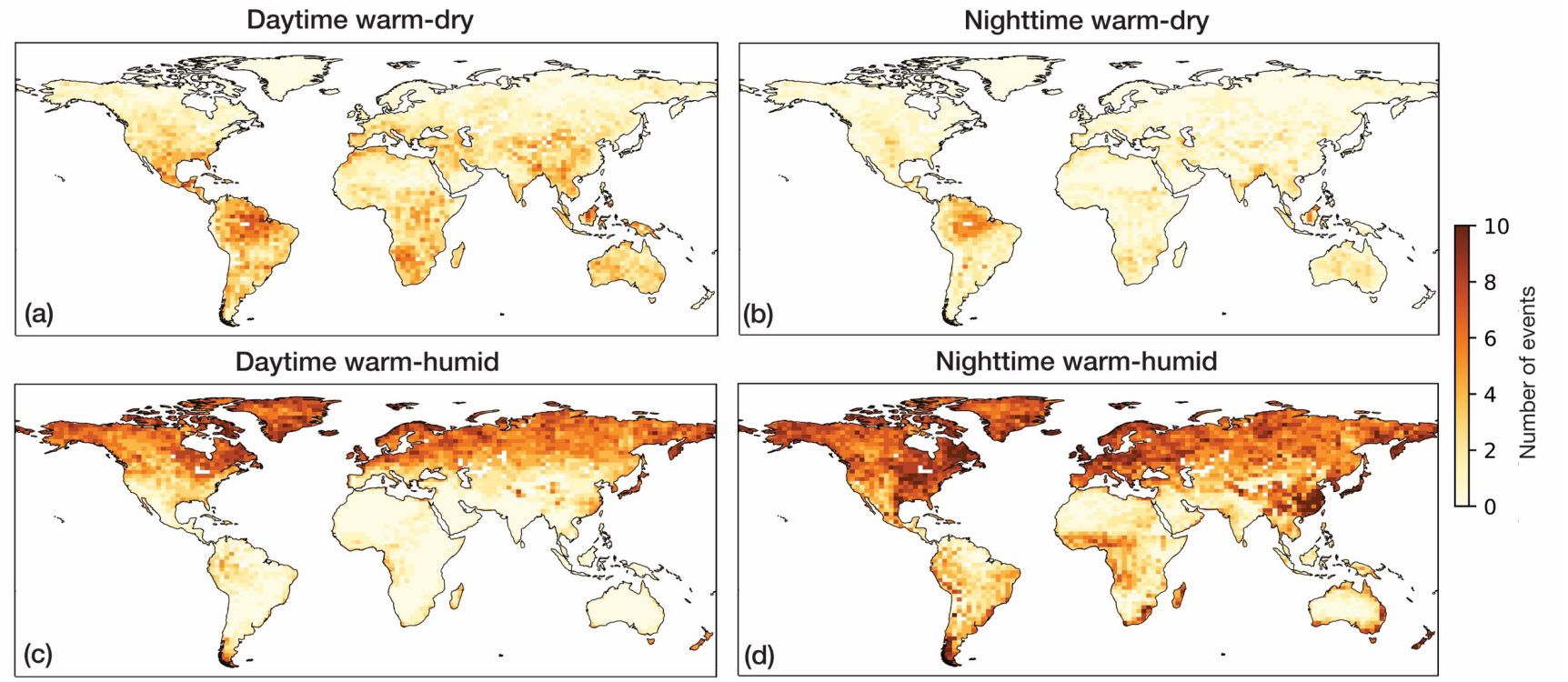
SM Figure 11. GISS ModelE2.1-G r[1-5]i1p1f2 forced difference in warm-dry and warm-humid 1955-2014 maximum event frequency relative to historical natural-only conditions based on a 12-month window. Each column presents the historical, hist-GHG, hist-aer, and land-hist difference in the event frequency relative to the historical natural-only event frequency (units in number of events). Grid cells where not all ensemble members agree on the sign of the forced event frequency difference relative to hist-nat are hatched.



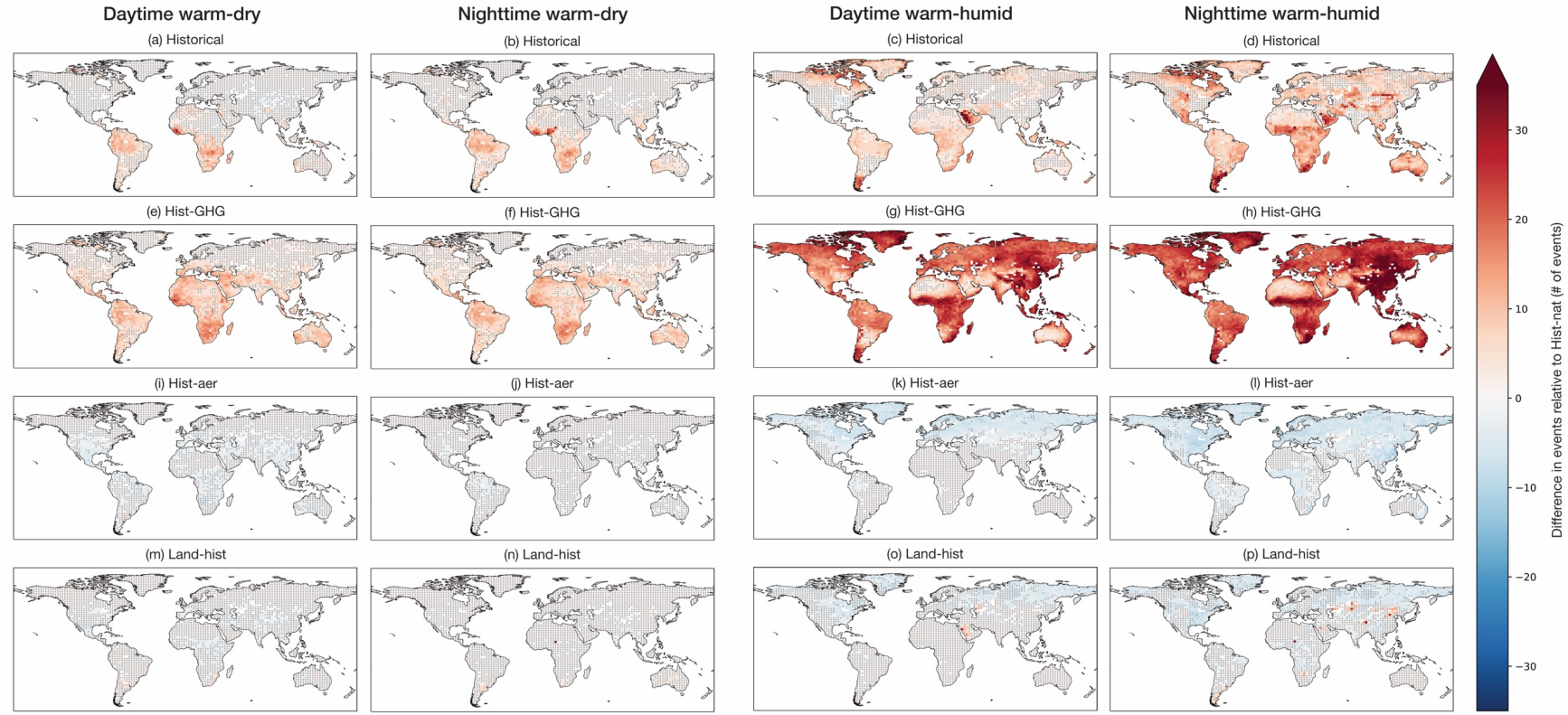
SM Figure 12. **GISS ModelE2.1-G r[1-5]i1p1f2 historical natural-only global distributions of warm-dry and warm-humid 1955-2014 event frequency based on a 80th percentile threshold.** a) Ensemble median daytime (Tmax) warm and dry maximum event intensity (standard value). b) Median nighttime (Tmin) warm and dry max event intensity. c) Median daytime warm and humid max event intensity. d) Median nighttime warm and humid max event intensity.



SM Figure 13. GISS ModelE2.1-G r[1-5]i1p1f2 forced difference in warm-dry and warm-humid 1955-2014 maximum event frequency relative to historical natural-only conditions based on a 80th percentile threshold. Each column presents the historical, hist-GHG, hist-aer, and land-hist difference in the event frequency relative to the historical natural-only event frequency (units in number of events). Grid cells where not all ensemble members agree on the sign of the forced event frequency difference relative to hist-nat are hatched.



SM Figure 14. **GISS ModelE2.1-G r[1-5]i1p1f2 historical natural-only global distributions of warm-dry and warm-humid 1955-2014 event frequency based on a 95th percentile threshold.** a) Ensemble median daytime (Tmax) warm and dry maximum event intensity (standard value). b) Median nighttime (Tmin) warm and dry max event intensity. c) Median daytime warm and humid max event intensity. d) Median nighttime warm and humid max event intensity.



SM Figure 15. GISS ModelE2.1-G r[1-5]i1p1f2 forced difference in warm-dry and warm-humid 1955-2014 maximum event frequency relative to historical natural-only conditions based on a 95th percentile threshold. Each column presents the historical, hist-GHG, hist-aer, and land-hist difference in the event frequency relative to the historical natural-only event frequency (units in number of events). Grid cells where not all ensemble members agree on the sign of the forced event frequency difference relative to hist-nat are hatched.