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The hemispheric asymmetry of ionospheric lunitidal signatures during Sudden Stratospheric Warmings in the eastern Asian and American sectors

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During Sudden Stratospheric Warming events, the ionosphere exhibits phase-shifted semi-diurnal perturbations, which are typically attributed to vertical coupling associated with the semi-diurnal lunar tide (M2). Our understanding of ionospheric responses to M2 is limited. This study focuses on fundamental vertical coupling processes associated with the latitudinal extent and hemispheric asymmetry of ionospheric M2 signatures, using total electron content data from the eastern Asian and American sectors. Our results illustrate that the asymmetry maximizes at around 15°N and 20°S magnetic latitudes. In the southern hemisphere, the M2-like signatures extend deep into midlatitude and, in the American sector, encounter the Weddell Sea Anomaly. The M2 amplitude is larger in the northern hemisphere and such asymmetry is more distinct in the eastern Asian sector. The hemispheric asymmetry of M2 signatures in the low latitude can be primarily explained by the trans-equatorial wind modulation of the equatorial plasma fountain. Other physical processes could also be relevant, including hemispheric asymmetry of the M2 below the F region, the ambient thermospheric composition and ionospheric plasma distribution, and the geomagnetic field configuration.