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Effects of high-latitude thermosphere heating at various scale sizes simulated by a nonhydrostatic model

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For the first time, a nonhydrostatic coupled 3-D Global Ionosphere-Thermosphere Model has been used at a very high spatial resolution of 2.5° longitude and 0.3125° latitude within simulations of increasing resolution to investigate the variability of high-latitude Joule and auroral heating. Even without the consideration of sub-grid scale electric field variability, the high-latitude mean Joule and auroral heating intensify significantly with increasing latitudinal resolution due mainly to resolving electric fields and auroral precipitation. At $\sim$ 370 km, the high-latitude mean resolved Joule heating increases by more than 40% from $5^{\circ} \times 5^{\circ}$ to $2.5^{\circ} \times 0.3125^{\circ}$. The associated increase in auroral heating is $\sim 20\%$. With increasing resolution, the high-latitude mean ion and neutral temperatures increase by $\sim$20 K in the thermosphere, while the high-latitude mean electron density shows decreasing and increasing tendencies in the upper thermosphere. Neutral winds intensify overall. In dark regions, electron density depletions can decrease Joule heating locally, despite the increase in the differential ion-neutral flow. At high spatial resolution, dynamical cooling associated with enhanced neutral wind horizontal divergence is significant, which offsets the effects of enhanced Joule heating, leading to the relatively small mean temperature increase.