Impacts of small-scale electric field and particle precipitation variabilities on Joule heating: GITM simulation

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Result 3: Impacts of small-scale variabilities on Joule heating

Simulation summary: Grid: 5° LON x 5° LAT; T, δT=150; Sep Equinox

<table>
<thead>
<tr>
<th>Run</th>
<th>Large-scale fields</th>
<th>Small-scale Evar</th>
<th>Small-scale PP var</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>Fig 4a</td>
</tr>
<tr>
<td>2</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>Fig 4b</td>
</tr>
<tr>
<td>3</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>Fig 4c</td>
</tr>
</tbody>
</table>

*Evar: Electric field variability  **PP var: Particle precipitation variability

1) Impacts of the small-scale electric field variability (Figs 4b vs 4a):
- 27% enhancement in Joule heating (150.54 GW→190.01 GW);

2) Impacts of the small-scale particle precipitation variability (Figs 4c vs 4b):
- The variable $\phi_E$ is calculated according to Fig 3b;
- Total Joule heating reduced by ~10 GW (190.01→180.11 GW, 5%);
- Fig 4d indicates that the localized reduction can reach ~17.5% at the dusk side, which is not negligible!

Summary

High-latitude electric field and particle precipitation:
- Their correlation depends on the location as well as the scale;
- On small scale, they are generally anti-correlated ($\Rightarrow$Current generator on small scale).

Impacts of the small-scale electric field and particle precipitation variabilities on Joule heating:
- The small-scale electric field variability leads to a significant enhancement in Joule heating;
- The anti-correlation between the small-scale particle precipitation and the small-scale electric field results in an overall 5% decrease in Joule heating. But the localized reduction can reach 17.5%, which is not negligible.