Improving Aerosol Simulations over South Asia for Climate and Air Quality Studies
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1. BACKGROUND AND MOTIVATION

Atmospheric pollution over South Asia attracts special attention due to its effects on regional climate, the water cycle, and human health. These effects are potentially growing owing to rising trends of anthropogenic aerosol emissions found there. However, it has been proved quite challenging to adequately represent the aerosol spatial distribution and magnitude over this critical region in global models (Pan et al. 2014), with the surface concentrations, aerosol optical depth (AOD), and absorbing AOD (AAOD) significantly underestimated, especially in October-January when the agricultural waste burning and anthropogenic aerosol dominate over dust aerosol (Figure 1 and 2). In this study, we aim to investigate the causes for such discrepancy in winter by conducting sets of model experiments with NASA's GEOS-5 in terms of (1) spatial resolution, (2) emission amount, and (3) meteorological fields.

2. EXPERIMENT DESIGNS WITH GEOS5

Table 2. Sensitivity experiments configurations

<table>
<thead>
<tr>
<th>Exp.</th>
<th>Aerosol Resolution</th>
<th>Anthropogenic Emission</th>
<th>Meteorological Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTL</td>
<td>1x1</td>
<td>1x1</td>
<td>No reply</td>
</tr>
<tr>
<td>EXP_two</td>
<td>2x2</td>
<td>Same as CTL</td>
<td>Same as CTL</td>
</tr>
<tr>
<td>EXP_half</td>
<td>0.5x0.5</td>
<td>Same as CTL</td>
<td>Same as CTL</td>
</tr>
<tr>
<td>EXP_free</td>
<td>1x1</td>
<td>Same as CTL</td>
<td>Same as CTL</td>
</tr>
<tr>
<td>EXP_free_2xC</td>
<td>1x1</td>
<td>Double Anthrop. BC &amp; OC</td>
<td>Same as CTL</td>
</tr>
</tbody>
</table>

3. RESULTS

A) Test Whether the Model Spatial Resolution is Inadequate

Figure 3. Compared to the satellite AOD from MODIS, the overall magnitude of AOD increases with the increase of spatial resolution from 2 degree (EXP_two) to half degree (EXP_half). However, the feature of high AOD over IGP region is still not captured in higher resolution.

B) Test Whether the Anthropogenic Emission is Inadequate

Figure 4. The overall amplitude of AOD increases with the doubling anthropogenic OC and BC emissions in EXP_2xC. However, the feature of high AOD over IGP region is still not captured.

C) Test Whether the Meteorological Fields are Poorly Represented

Figure 5. The feature of high AOD over IGP region was captured better in EXP_free and thus in EXP_free_2xC.

Figure 6. Difference between EXP_free from CTL. The OC and sulfate AOD are higher over IGP in EXP_free. The relative humidity (RH) and wind are better simulated in EXP_free.

4. CONCLUSIONS

- Realistic meteorological fields, especially wind and relative humidity, are essential to adequately represent the high AOD over IGP (Indo-Gangetic Plain).
- Higher spatial resolution and anthropogenic emission also contribute to the improvement of AOD.
- Other factors, such as lack of nitrate and low cloud in GEOS5, are critical as well, which are under investigation.

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REFERENCES