Abstract

Air pollution increases mortality risk up to 18 percent due to cardiovascular causes. Poor air quality occurs more often when meteorological components prevent the dispersal of pollutants in the lower atmosphere. Atmospheric and hydrological patterns are projected to change as global warming alters the seasonal circulation and precipitation. The study uses an air stagnation index (ASI) to quantify the meteorological conditions that allow poor air quality. We examined ASI by season given that each season is dominated by the distinct synoptic meteorological characteristics. By looking at individual seasons, we aimed to better explain the change of stagnation events. Here, we applied the ASI to the bias-corrected Coupled Model Intercomparison Project (CMIP5) ensemble prediction data. An exploratory analysis of CMIP5 model biases suggested that the occurrence of stagnation days and duration of stagnation events have different seasonal patterns, and fluctuated spatially. Our result suggests that stagnation is very likely to increase among various regions of the world, including those areas with historical pollution issues. To complete this study, we will apply statistical analyses in conjunction with multi-model agreement criteria to quantify the robustness of air stagnation change. Future work will include tuning the ASI Metric for specific regions of interest.

Why China?

Understand the links among climate change, synoptic phenomena, and local stagnation in China.

Global warming-driven stagnation changes are analyzed using an ensemble of realizations from 15 modeling groups that provide daily three-dimensional atmospheric fields from both historical and RCP6 experiments of the CMIP5. Historical 20 years (1986-2005) and recent 30 years (2014-2016) were analyzed.

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Results: Global Stagnation

- Projected changes were spatially heterogeneous
- Increase of approximately 1-6 days per season in the period
- Increase of ASI in industrialized regions, including eastern China, west U.S., and northern India, Mediterranean Europe.
- Increase of 8-14 days during winter and spring in northern South Africa (Figure 1a and d).
- Higher latitude in northern hemisphere (Siberia) demonstrated an increase of 2-8 stagnation days throughout the winter season except spring.
- Stagnation days had increased mostly in spring and autumn. More populated areas had an above average projected increase of 8-15 days for spring and autumn.

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Results: Regional---China

Results: Seasonal Bias Correction(BC) Improvement

Table 1. a) Percent improvement of bias corrected stagnation days of individual component compared to observations. b) Percent improvement in percentile of bias corrected raw data of individual component compared to observations.

<table>
<thead>
<tr>
<th>Component</th>
<th>DJF</th>
<th>Jan</th>
<th>MAM</th>
<th>JJA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASI (Precip)</td>
<td>3.74324</td>
<td>2.89534</td>
<td>1.5076</td>
<td>2.10547</td>
</tr>
<tr>
<td>ASI (50mb Wind)</td>
<td>1.90263</td>
<td>0.44364</td>
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Evaluation potential for changes in all seasons in accurate long-term projections of air quality is necessary. Previous studies have been limited as they only used annual analyses. To fill this gap in literature, this study focuses on the seasonal perspective.

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