Estimating the correlation between aerosol and precipitation and cloud in The Sichuan Basin using CCA

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Abstract

• The increasing of AOD over northwestern SB can decrease the LCC the most SB, and the increasing of AOD over the west of the southeastern-northwestern diagonal can increase the LCC nearby; the impact of AOD on LCC has faded much 1 day after AOD changed.

• AOD can influence LSP like as LCC; the affected LSP is always downwind LCC and AOD.

• The circulation does be an importent factor on impact of AOD on LSP or LCC in autumn in the SB.

Key Words: aerosol, precipitation, cloud, Sichuan Basin, Autumn

Methods and Data

• Re-analysis assimilates data provided by the European Centre for Medium-range Weather Forecast (ECMWF) for the Monitoring Atmospheric Composition and Climate (MACC) project.

• Total aerosol optical depth (AOD).

• Low cloud cover (LCC).

• Large-scale precipitation (LSP) (stratiform precipitation).

• September, October and November 2003–2012.

• Standard empirical orthogonal functions (EOF).

• Canonical correlation analysis (CCA).

CCA

The canonical correlation coefficients (CCCs) of first 2 pairs of CCA between AOD and LCC, AOD and LSP for 3 kinds of time lag.

<table>
<thead>
<tr>
<th>CCA</th>
<th>0 day</th>
<th>1 day</th>
<th>2 days</th>
<th>0 day</th>
<th>1 day</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOD-LCC</td>
<td>AOD-LSP</td>
<td>AOD-LCC</td>
<td>AOD-LSP</td>
<td>AOD-LCC</td>
<td>AOD-LSP</td>
</tr>
<tr>
<td>CCA1</td>
<td>0.68</td>
<td>0.56</td>
<td>0.42</td>
<td>0.48</td>
<td>0.42</td>
</tr>
<tr>
<td>CCA2</td>
<td>0.59</td>
<td>0.37</td>
<td>0.36</td>
<td>0.29</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Note: the coefficients with * pass the Bartlett Test.

EOF

The Explained Variance of First 7 EOFs for AOD, LCC and LSP (%)

<table>
<thead>
<tr>
<th>EOF1</th>
<th>EOF2</th>
<th>EOF3</th>
<th>EOF4</th>
<th>EOF5</th>
<th>EOF6</th>
<th>EOF7</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOD</td>
<td>52.89</td>
<td>16.24</td>
<td>6.78</td>
<td>5.93</td>
<td>2.87</td>
<td>2.57</td>
</tr>
<tr>
<td>LCC</td>
<td>36.55</td>
<td>15.55</td>
<td>11.11</td>
<td>6.32</td>
<td>4.43</td>
<td>2.85</td>
</tr>
<tr>
<td>LSP</td>
<td>41.65</td>
<td>19.13</td>
<td>9.83</td>
<td>7.43</td>
<td>4.50</td>
<td>2.97</td>
</tr>
</tbody>
</table>

R_kis variance, \( \sum_{i=1}^{k} R_{k, AOD} = 89.36\% \), \( \sum_{i=1}^{k} R_{k, LCC} = 79.44\% \), \( \sum_{i=1}^{k} R_{k, LSP} = 87.89\% \)

The EOF1 should be variables’ climatology change or distribution.

The EOF2 presents two branches with opposite sign of variability: the northwestern branch over Sichuan province, and southeastern branch over Chongqing City.