Improved inversion of aerosol components in the atmospheric column from remote sensing data

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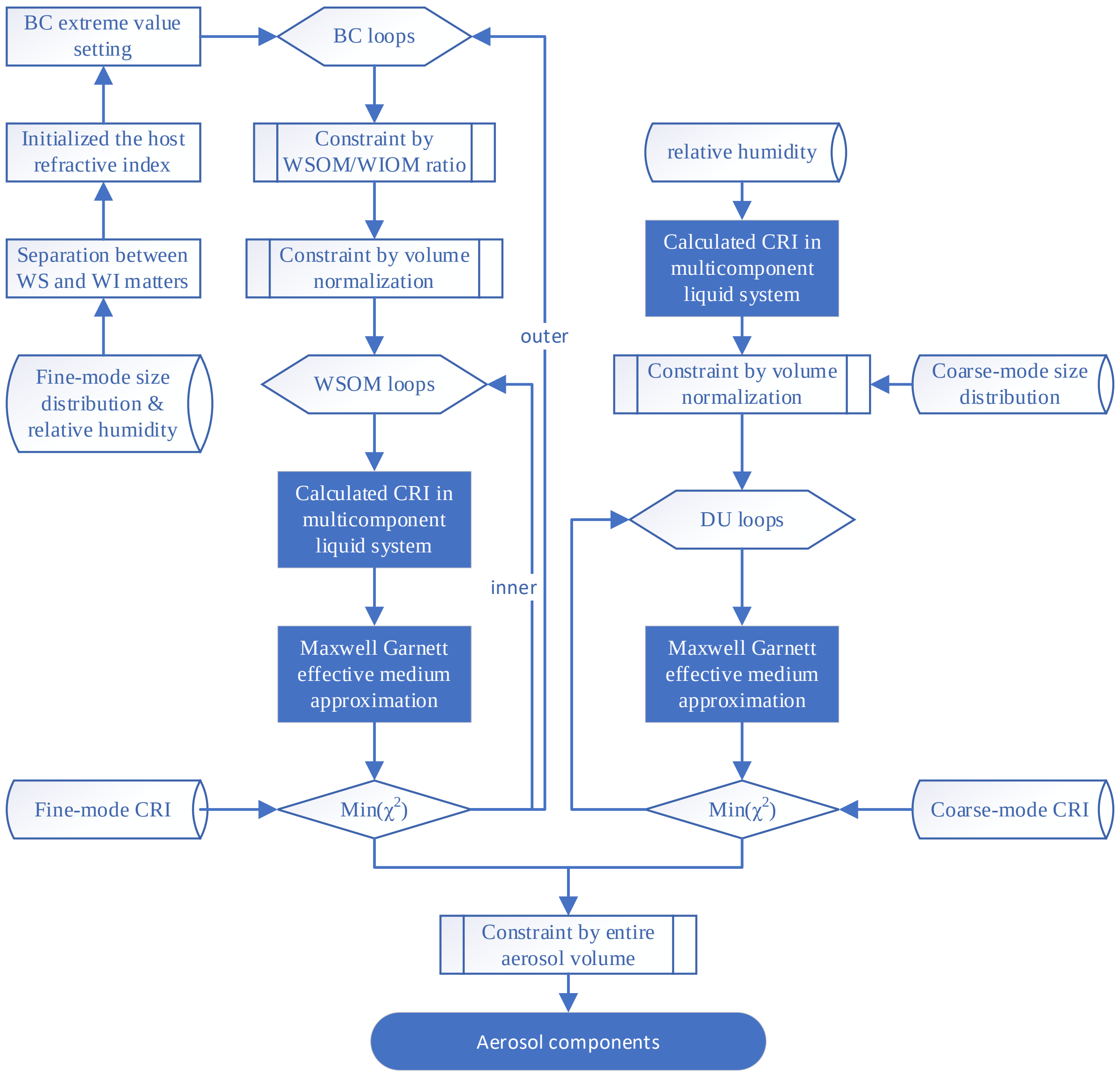
Methodology

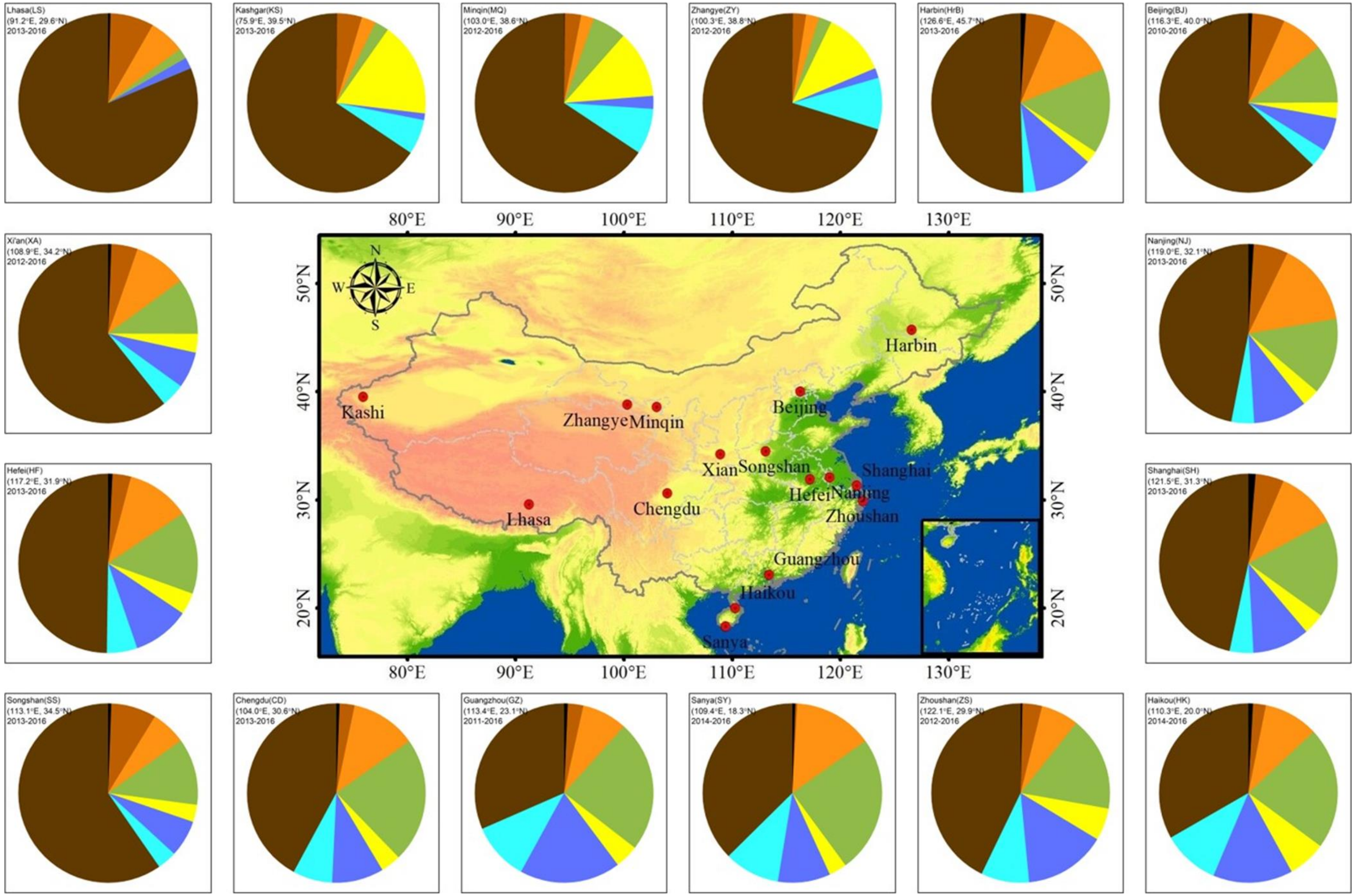
The aerosol components in this algorithm comprise five species, combining eight sub-components including:

- black carbon (BC)
- water-soluble (WSOM), water-insoluble organic matter (WIOM)
- ammonium nitrate(AN), sodium chloride (SC)
- dust-like (DU)
- aerosol water content (AWf and AWc)



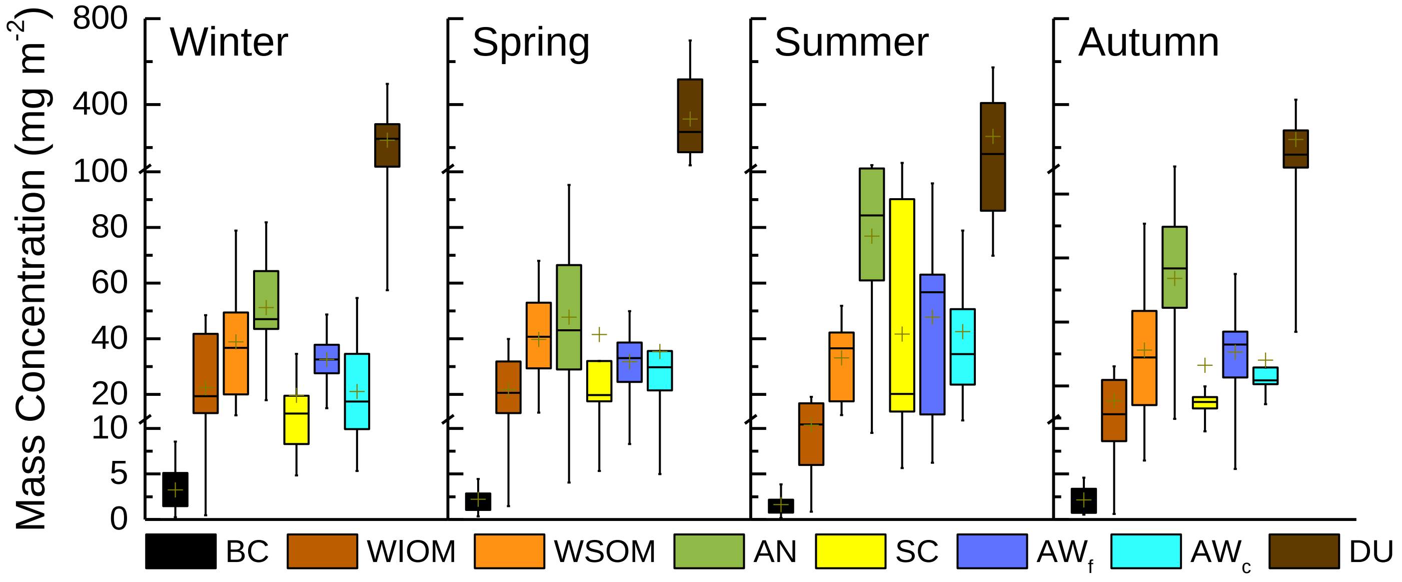
Distribution of aerosol components over China

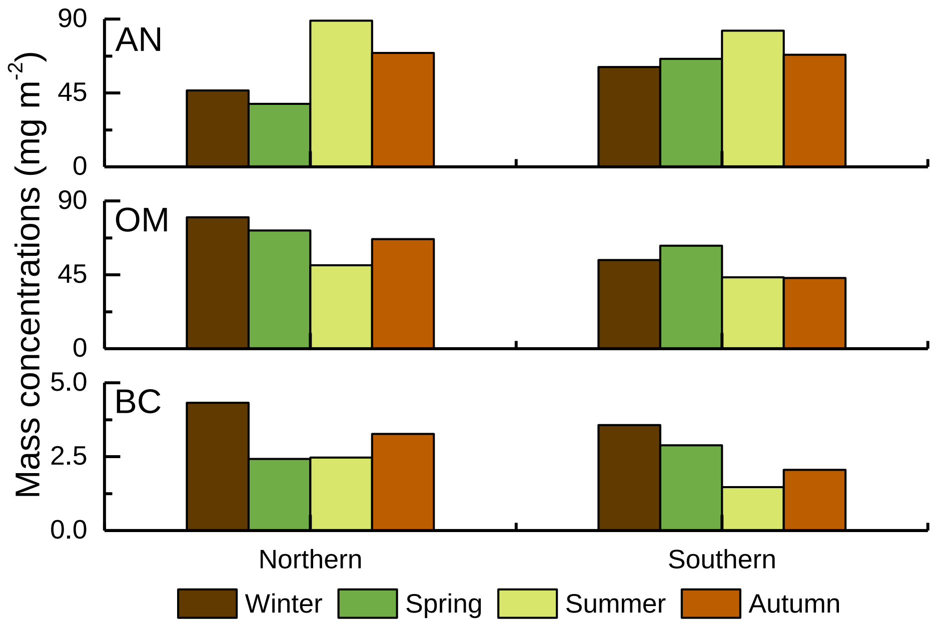
- The atmospheric columnar DU component is dominant in the northern region of China, whereas the AW is higher in the southern coastal region.
- The SC component retrieved over the desert in northwest China originates from a paleo-marine source.
- The AN significantly decreased from 2011 to 2016, by 21.9 mg m-2, which is inseparable from China's environmental control policies.



Seasonal differences over south and north China

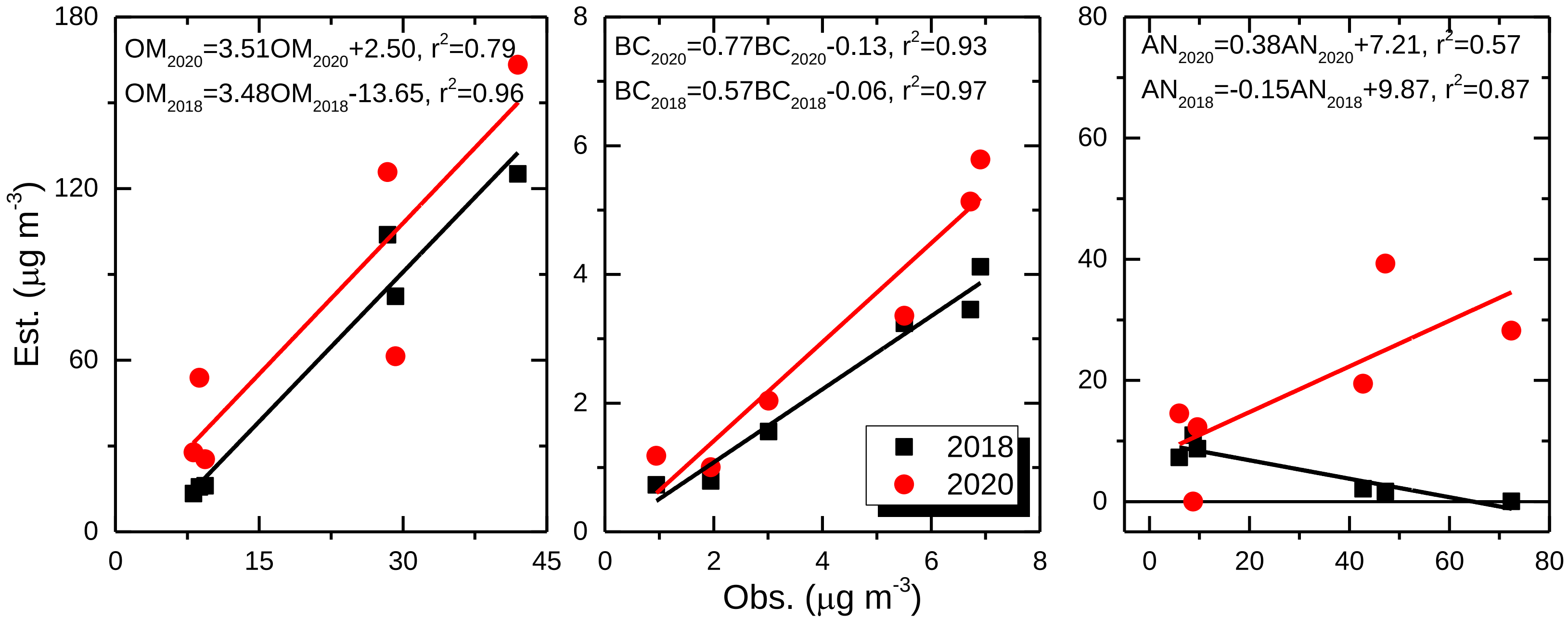
- BC concentrations in typical northern regions are higher than in southern regions, because of emissions due to winter heating only in the north.
- The higher mass concentration of mean AN in the southern region suggests that more AN is produced by secondary reactions in the humid climate in the south than in the northern region.





Comparison with surface observations

- OM components from the improved algorithm (2020) have good correlation with observations.
- Black carbon is closer to the identity line although the correlation coefficient is slightly smaller than that in 2018.
- For AN, the improved algorithm (2020) shows a good effect. The slope with ground observations changes from negative to positive.



The method presented can be used not only for ground-based sun-sky photometer measurements, but also for other remote sensing instruments (e.g. Lider), and even for satellite remote sensing in the future. Meanwhile, as long as measurements of multi-wavelength extinction coefficients and aerosol size distributions are available, the inversion of aerosol composition can also be performed using surface observations. Therefore, this method can be widely used in low-cost and wide-area measurements in the future, providing a possibility for obtaining the global distribution of aerosol composition.