Resource-emission nexus management

With the support by the National Natural Science Foundation of China, the research team led by Prof. Chen Bin (陈彬) at the State Key Joint Laboratory of Environmental Simulation and Pollution Control, School of Environment, Beijing Normal University, uncovered the resource-emission nexus effects in socio-economic systems, which was published in *Science Advances* (2019, 5: eaav4707) as a highlighted paper.

The resource nexus thinking has emerged over 15 years to understand and reconfigure the linkages among multiple resources. However, the spillover impacts of associated emissions between different regions are often ignored. The idea of resource-emission nexus was thus proposed by Prof. Chen's group to investigate the interconnection among various resources and emissions and provide coordinated management strategies and policies. The economic input-output models and ecological network models are integrated to simulate tradeoffs and synergies between resource flows embracing energy, water, food, land, and emissions including CO_2, NO_x, and $PM_{2.5}$ within socio-economic systems. A series of studies have been published in *Applied Energy* and *Environmental Science & Technology*.

Moreover, they combined the economic-ecological model with biophysical model to address the synergetic effects and spillover impacts of hybrid resource-emission flows under regional environmental policies. The nested-grid GEOS-Chem model was incorporated to simulate air pollution concentrations at high resolution and the atmospheric transport of spillover emissions with a case study of Beijing-Tianjin-Hebei (JJJ) region. The results show that the actual reduction of current primary $PM_{2.5}$ emissions and precursor emissions under the JJJ air policy scenario would be 9% higher than the policy target. Interestingly, such clean air policy can also result in co-benefits, i.e., reducing CO_2 emissions and water consumption in the target region as well.

The nexus feature and unintended effects revealed in the *Science Advances* paper may help manage multi-regional resource utilization and emission mitigation in terms of interacting socio-economic, physical, chemical, and biological processes, which enables the new resource-emission nexus governance with a vision beyond a regional and single-problem focus for tackling the tele-connected and cross-sectional environmental problems.

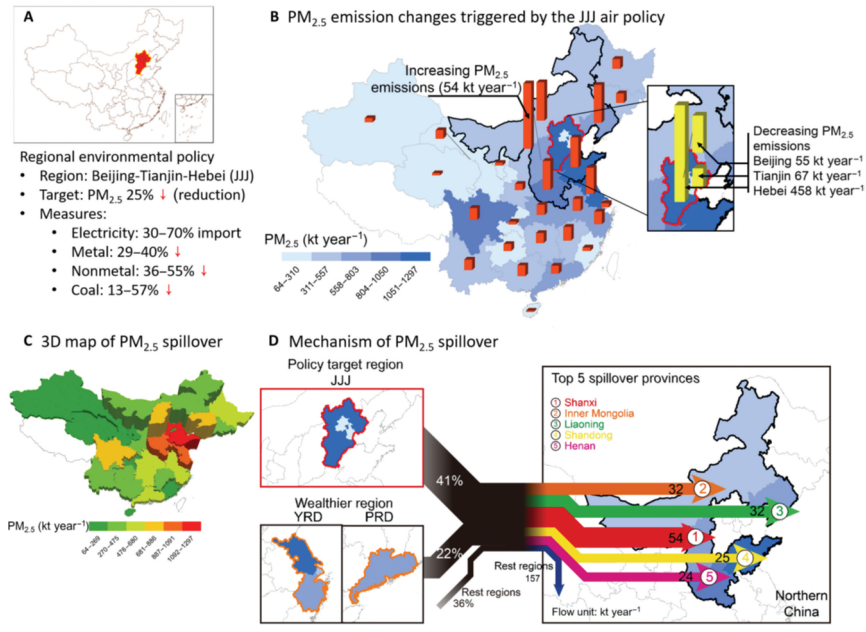

Figure Primary $PM_{2.5}$ emission changes triggered by the JJJ clean air policy.