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Study of Chinese pollution with the 3D regional chemistry transport CHIMERE model and remote sensing observations, with a focus on mineral dust impacts

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Since the end of the 20th century, China has observed important growth in numerous sectors. China's Gross Domestic Product (GDP) has been multiply by 4 during the 2000-2010 decade (National Bureau of Statistics of China), mostly because of the industry's growth. These evolutions have been accompanied by important increases of atmospheric pollutants emissions (Yinmin et al, Atmo Env, 2016). As a consequence and for about 10 years now, Chinese authorities have been working to reduce pollutant levels, because atmospheric pollution is a major health issue for Chinese population especially within cities, for which World Health Organisation's standards for major pollutants (Ozone, PM2.5, PM10) are often exceeded. Particles have multiple issues, as they impact on health and global warming. Their impacts will depend on their sources (primary or secondary pollutants) and natures (Particle size distribution, chemical composition...). Controlling particles loading is a complex task as their sources are various and dispersed on the Chinese territories: mineral dust can be emitted from Chinese deserts in large amount (Laurent et al., GPC, 2006), ammonia can be emitted from agriculture and livestock (Kang et al., ACP, 2016) and lots of urban primary pollutants can be emitted from urbanized areas. It is then necessary to work from a continental to local scales to understand more precisely pollution of urbanized areas. It is then mandatory to discriminate and quantify pollution sources and to estimate the impact of natural pollution and the major contributing sources.
We propose here an approach based on a model and satellite observation synergy to estimate what controls Chinese pollution. We use the regional chemistry transport model CHIMERE (Menut et al., GMD, 2013) to simulate atmospheric pollutants concentrations. A large domain (72°E-145°E; 17.5°N-55°N), with a $\frac{1}{4}°$x$\frac{1}{4}°$ resolution is used to make multi-annual simulations. CHIMERE model include most of the pollutants sources, and using a soil properties database is able to model Dust emissions (Laurent B. et al., JGR, 2005). Satellite products are available to evaluate and improve our simulations, as for example the AOD and Angstrom coefficient from the MODIS instrument. Mineral dust pollution represents one of the most important sources of atmospheric pollutant over Chinese territories, but dust emissions and transport present important seasonal variabilities. To evaluate impacts of dust pollutants on inhabited areas' pollutions, we compute dust emissions (Marticorena and Bergametti, JGR, 1995) and transport. Using MODIS instrument information over dust source regions, we control that AOD amplitudes and temporal variations simulated with CHIMERE correspond. We attempt to quantify the impact of mineral dust pollution each month over several urbanized areas using multi-annual simulations (2011, 2013, and 2015). We also investigate the impact of heavy dust events within inhabited areas' pollution.

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