Increasing nitrogen oxides (NOx) emissions over the fast developing regions have been of great concern due to their critical associations with the aggravated haze and climate change. However, little geographically specific data exists for estimating spatio-temporal trends of NOx emissions. In order to quantify the spatial and temporal variations of NOx emissions, a spatially explicit approach based on the continuous satellite observations of artificial nighttime stable lights (NSLs) from the Defense Meteorological Satellite Program/Operational Linescan System (DMSP/OLS) was developed to estimate NOx emissions from the largest emission source of fossil fuel combustion. The NSL based model was established with three types of data including satellite data of nighttime stable lights, geographical data of administrative boundaries, and provincial energy consumptions in China, where a significant growth of NOx emission has experienced during three policy stages corresponding to the 9th-11th)Five-Year Plan (FYP, 1995-2010). The estimated national NOx emissions increased by 8.2% per year during the study period, and the total annual NOx emissions in China estimated by the NSL-based model were approximately 4.1%-13.8% higher than the previous estimates. The spatio-temporal variations of NOx emissions at city scale were then evaluated by the Moran's I indices. The global Moran's I indices for measuring spatial agglomerations of China's NOx emission increased by 50.7% during 1995-2010. Although the inland cities have shown larger contribution to the emission growth than the more developed coastal cities since 2005, the High-High clusters of NOx emission located in Beijing-Tianjin-Hebei regions, the Yangtze River Delta, and the Pearl River Delta should still be the major focus of NOx mitigation. Our results indicate that the readily available DMSP/OLS nighttime stable lights based model could be an easily accessible and effective tool for achieving strategic decision making toward NOx reduction.